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Choi et al.

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(54) **LIGHT EMITTING DEVICE**

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(22) Filed: **May 27, 2014**

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Related U.S. Application Data

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(30) **Foreign Application Priority Data**

Nov. 15, 2011 (KR) 10-2011-0119144

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H01L 31/00 (2006.01)
H01L 33/40 (2010.01)
H01L 33/38 (2010.01)

(52) **U.S. Cl.**
CPC ***H01L 33/405*** (2013.01); ***H01L 33/38*** (2013.01); *H01L 2924/0002* (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

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(57) **ABSTRACT**

A light emitting device including a light emitting structure having a first semiconductor layer, a second semiconductor layer, and an active layer between the first and second semiconductor layers; a first electrode electrically connected to the first semiconductor layer; and a second electrode disposed on the second semiconductor layer. Further, the second electrode include a reflective layer disposed on the second semiconductor layer; a metal layer disposed on a side surface of the reflective layer and on a top surface of reflective layer; a first anti-oxidation layer on the metal layer; and a second anti-oxidation layer on the first anti-oxidation layer. In addition, the second anti-oxidation layer is more than 10 times thicker than the first anti-oxidation layer.

17 Claims, 24 Drawing Sheets

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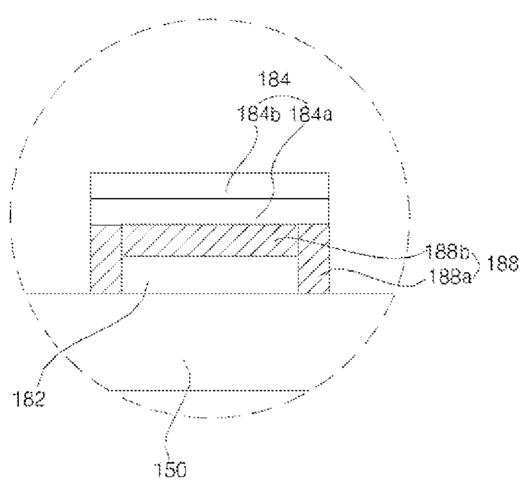

FIG. 1

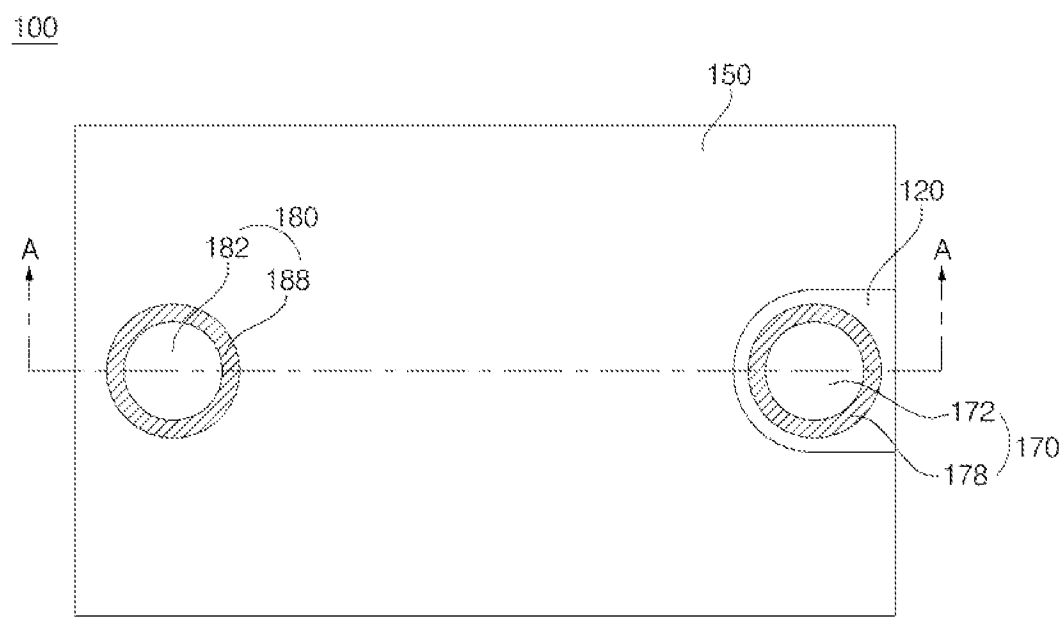

FIG. 2

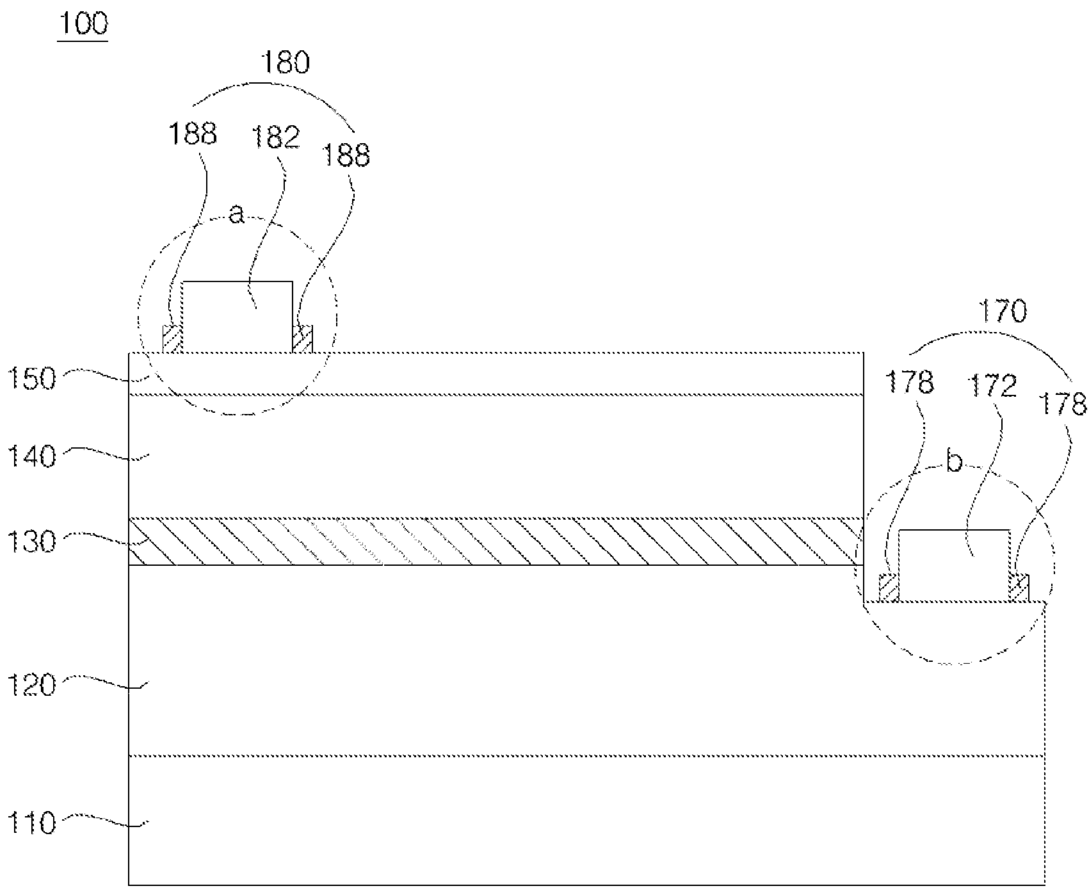

FIG. 3

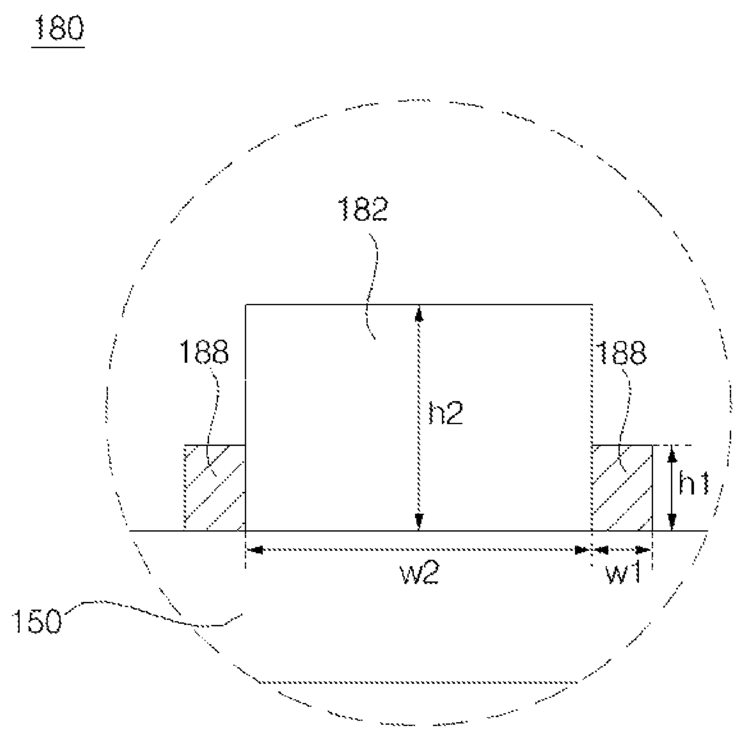

FIG. 4

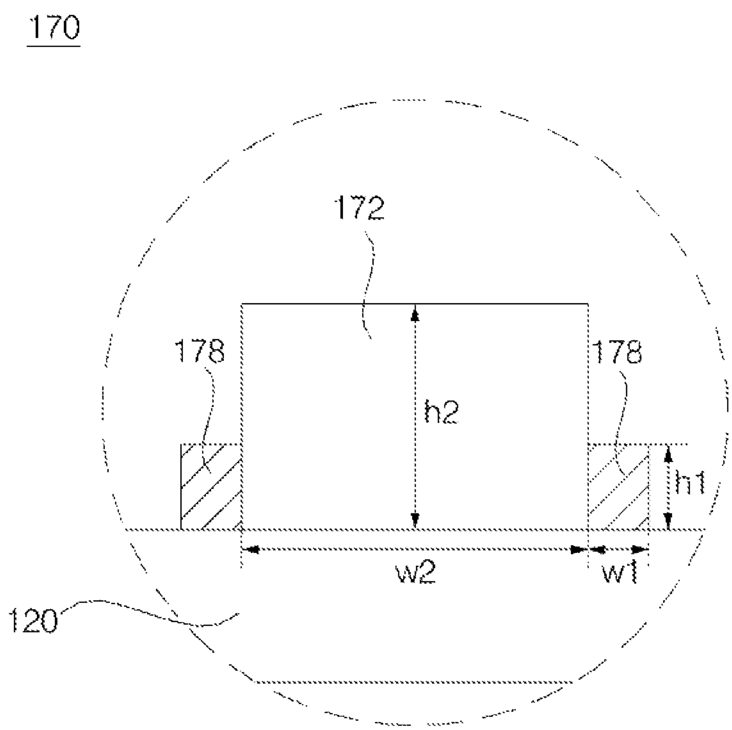

FIG. 5

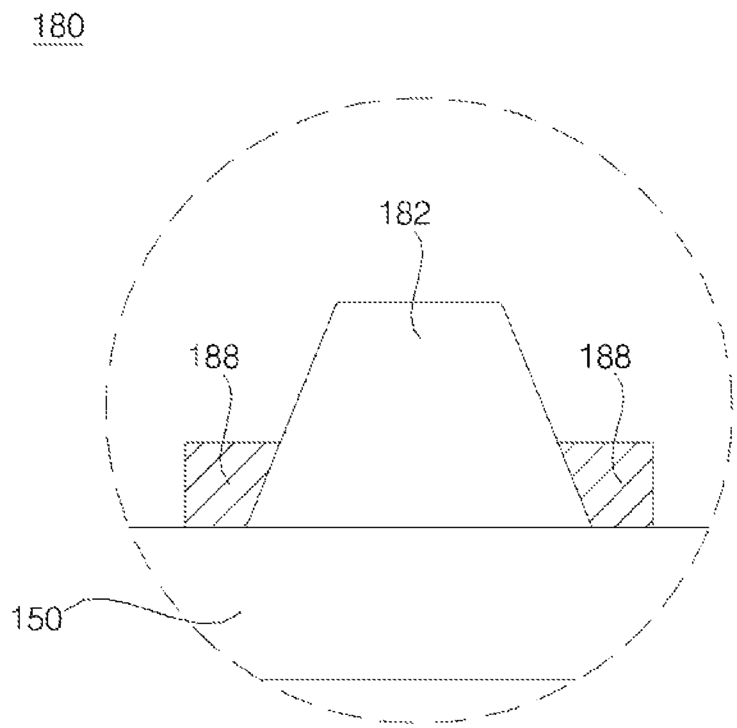

FIG. 6

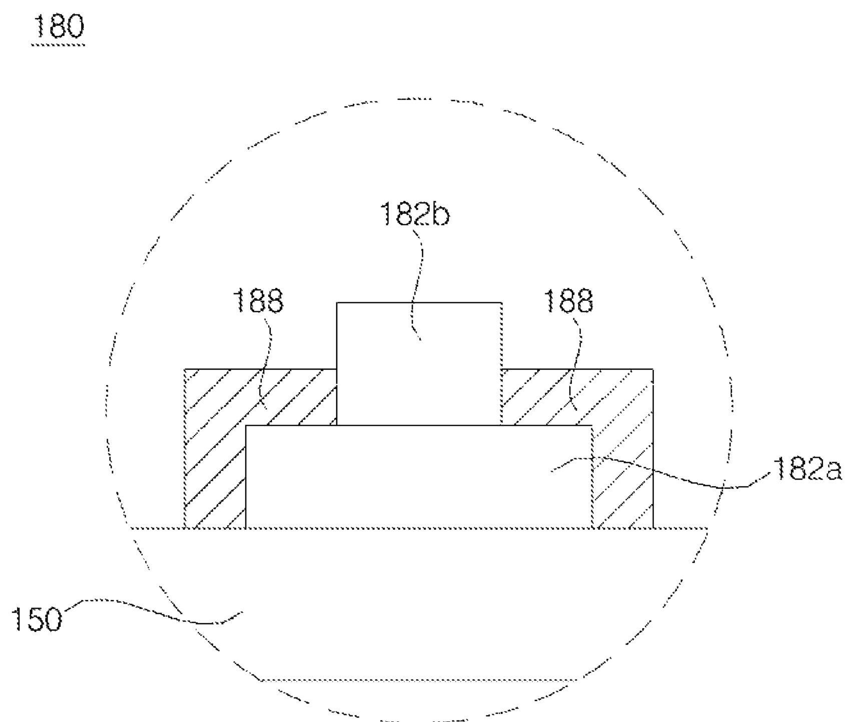

FIG. 7

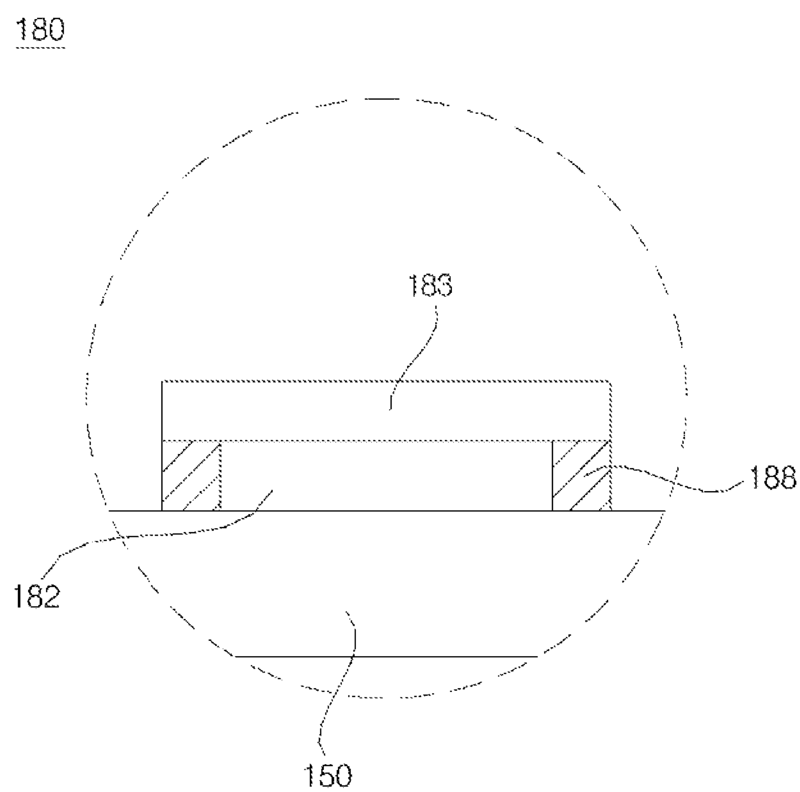

FIG. 8

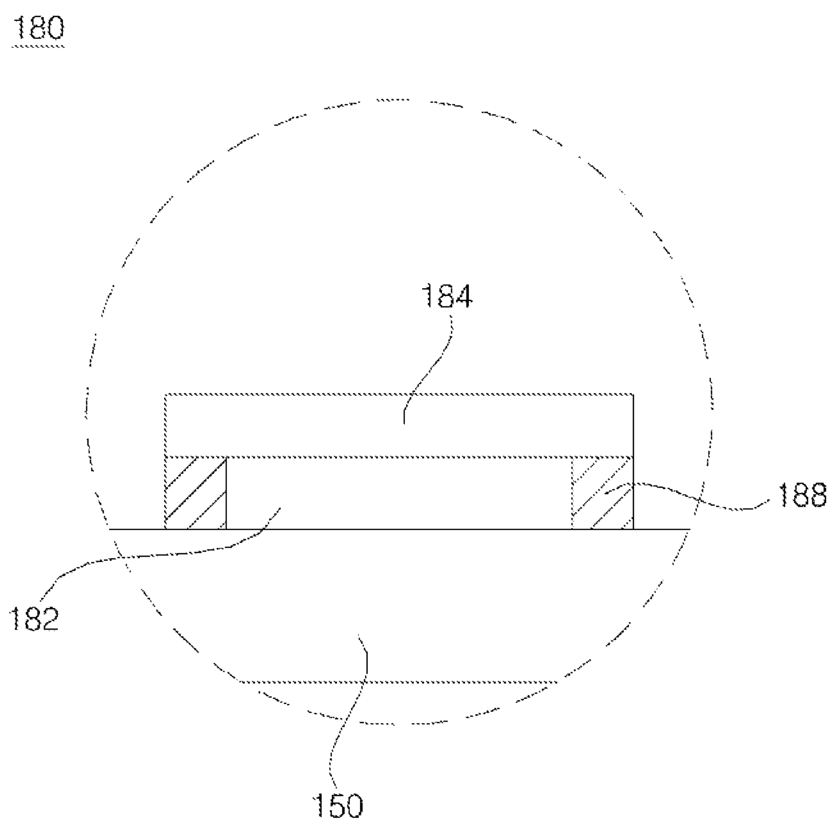

FIG. 9

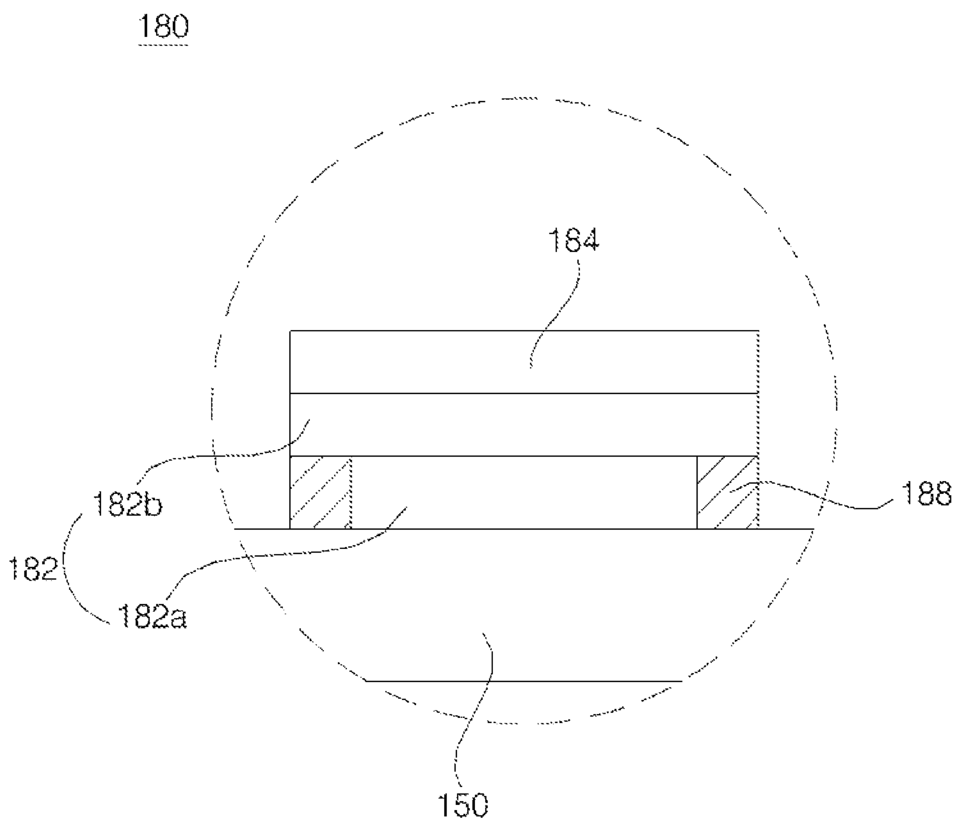

FIG. 10

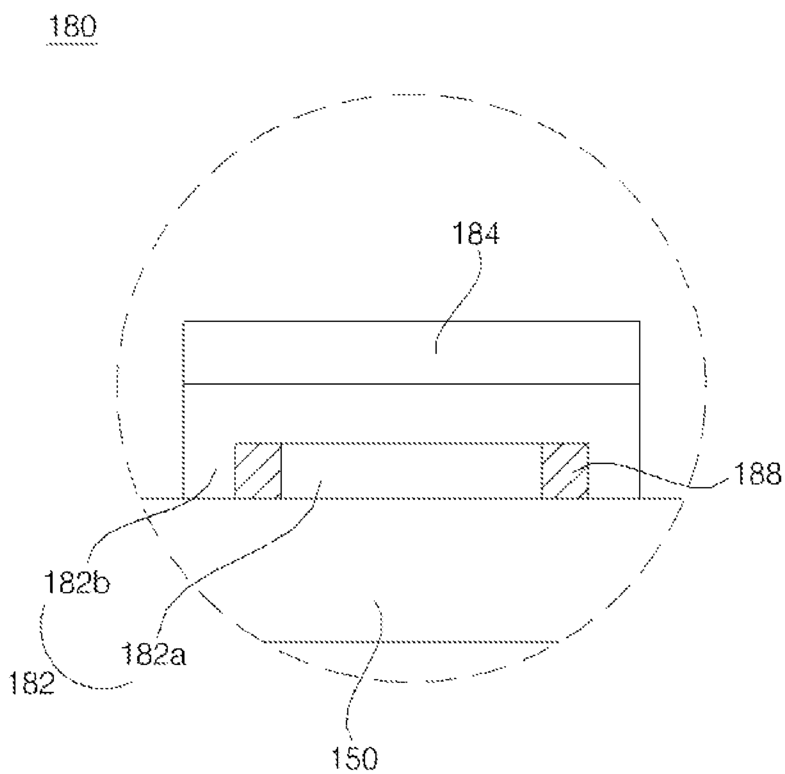

FIG. 11

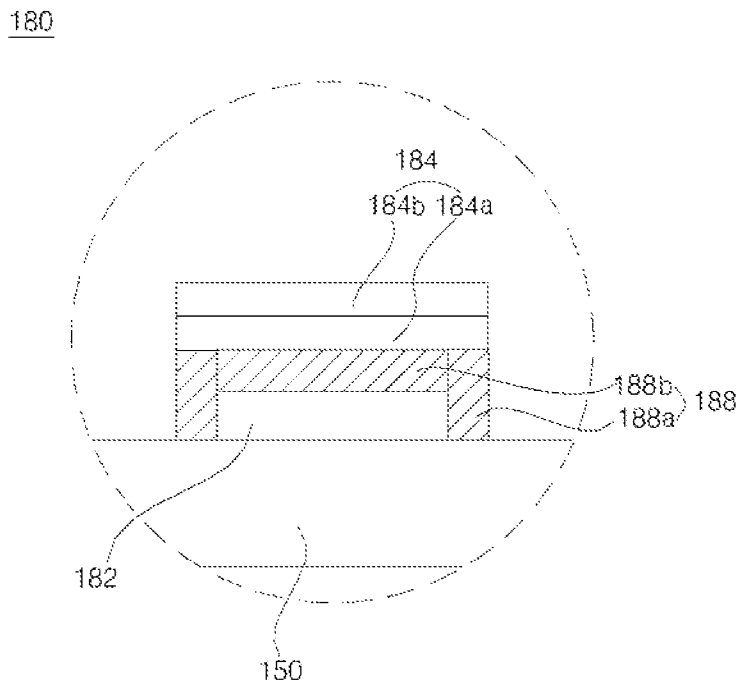

FIG. 12

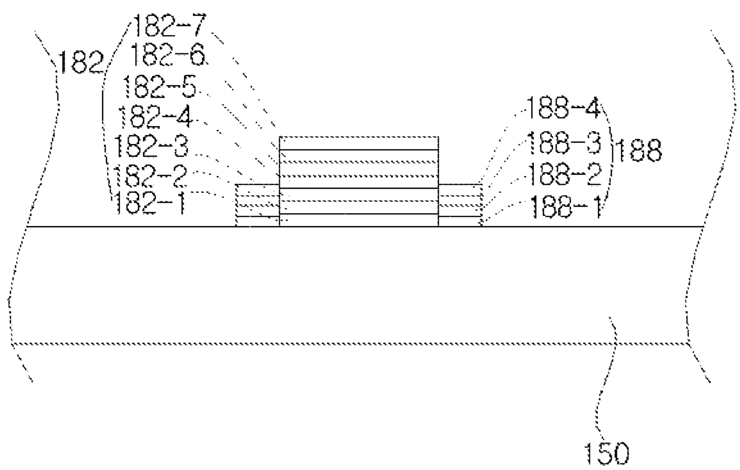
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FIG. 13

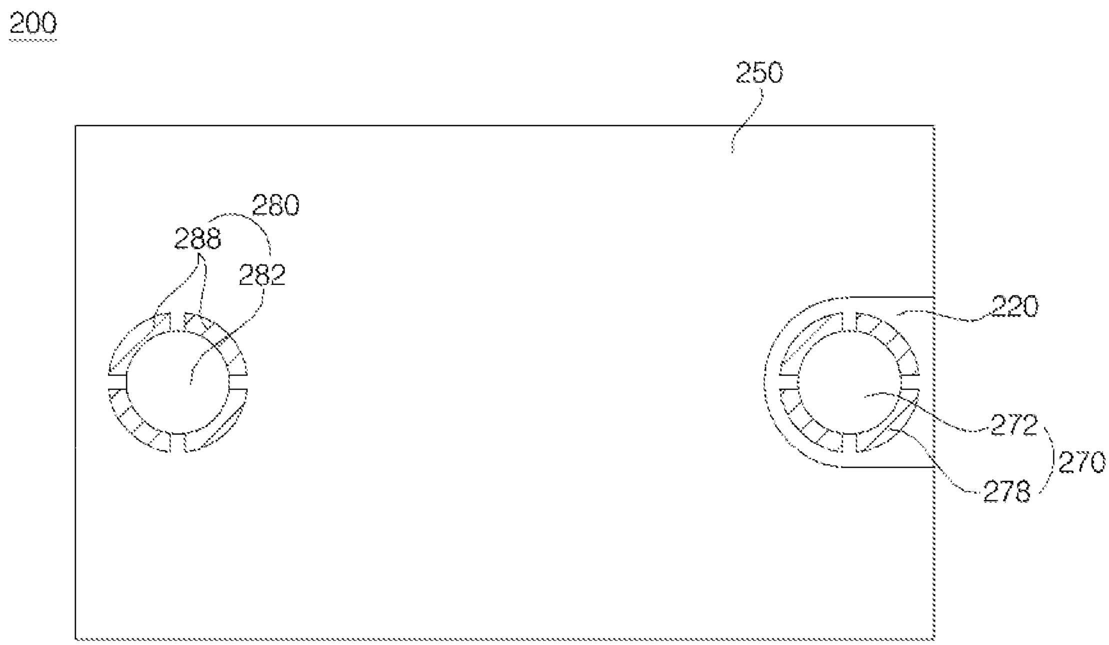


FIG. 14

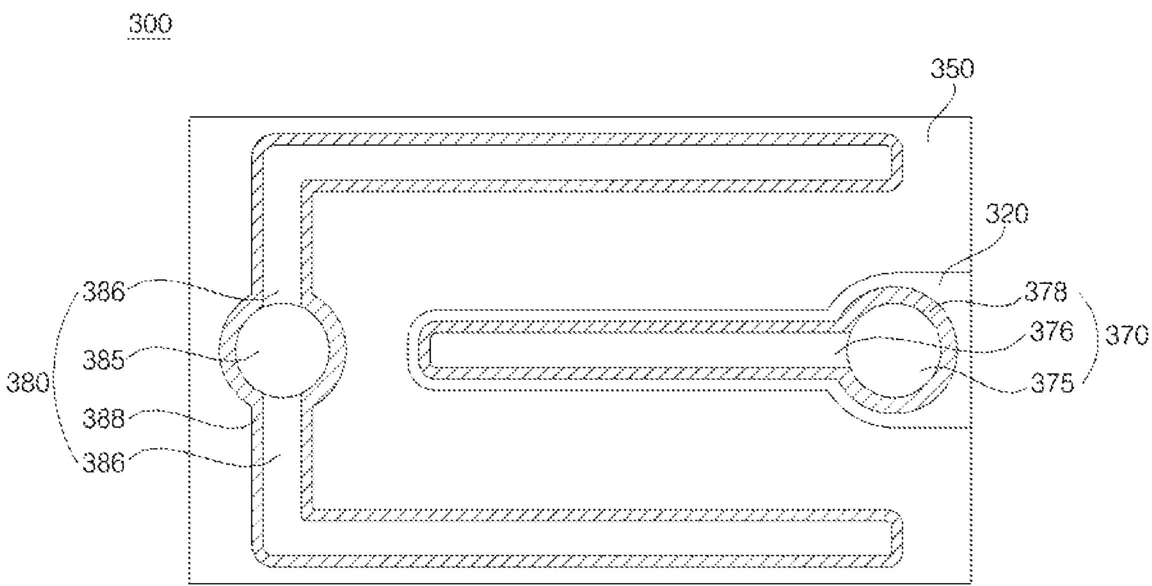


FIG. 15

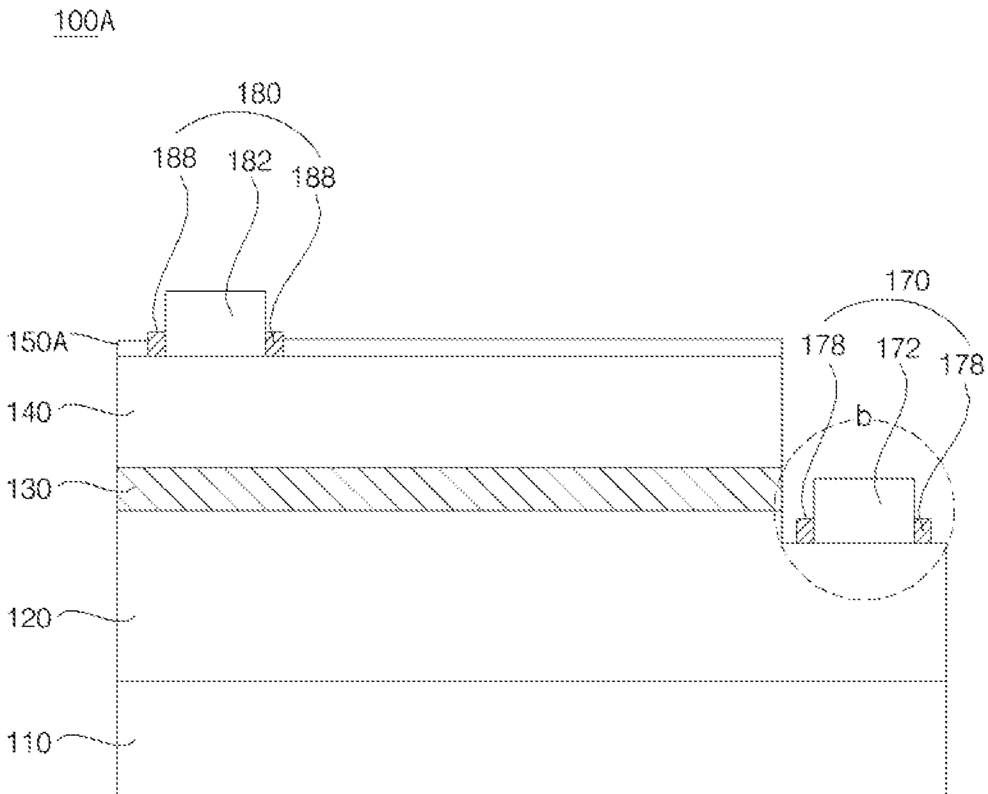
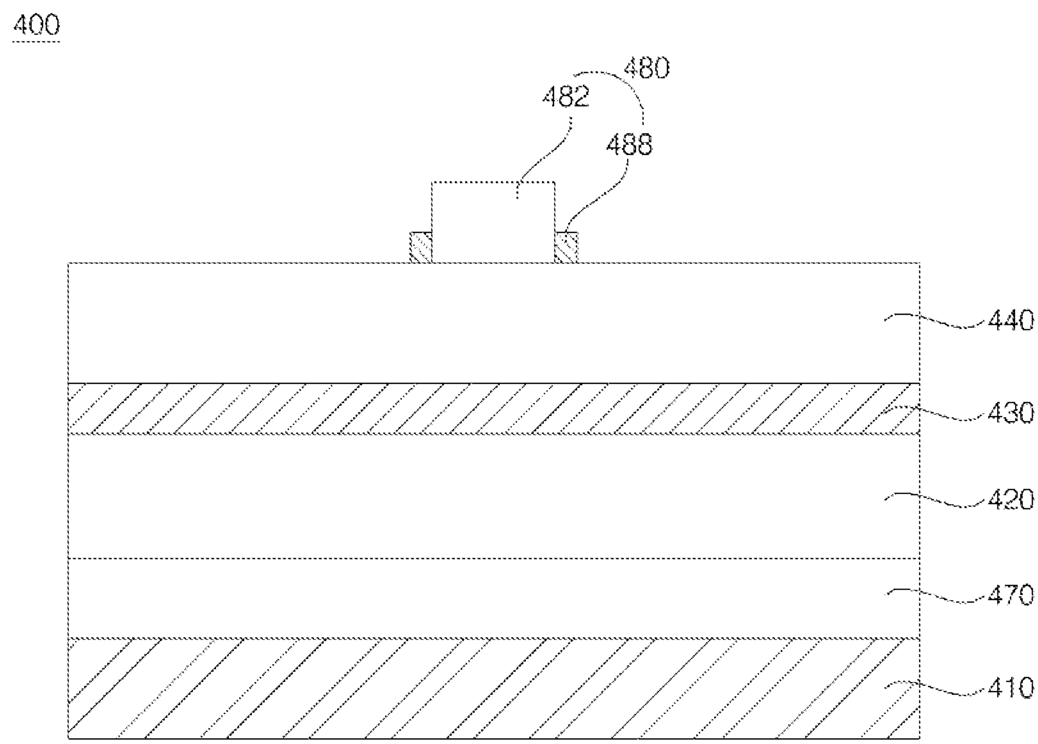


FIG. 16



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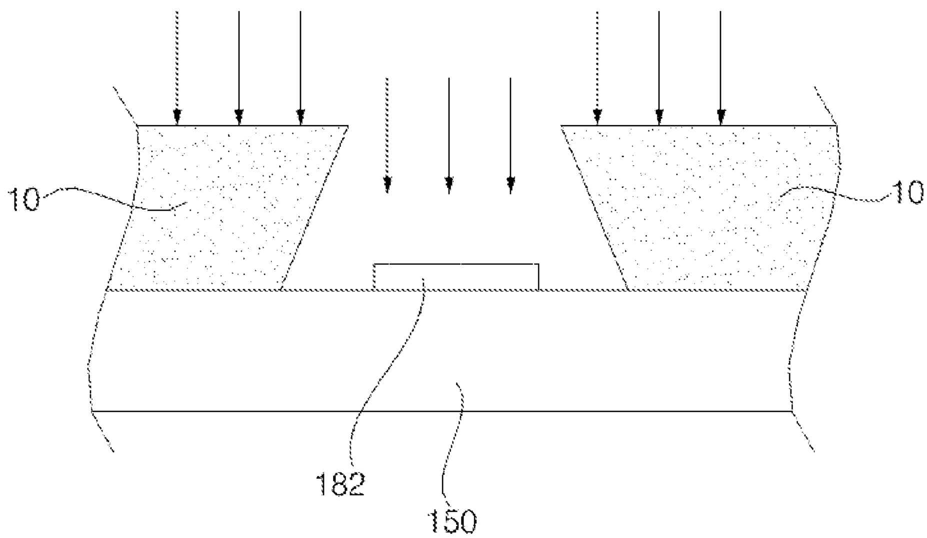


FIG. 18

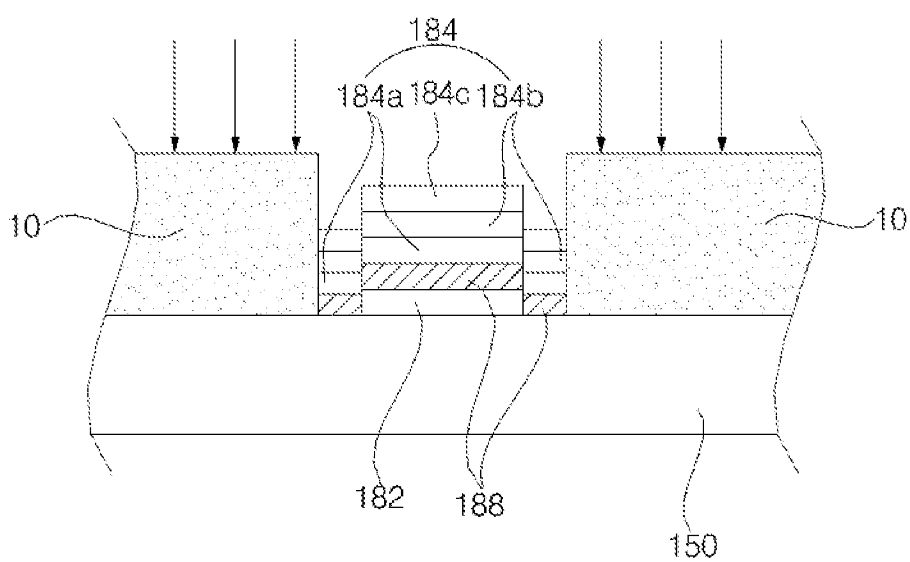


FIG. 19

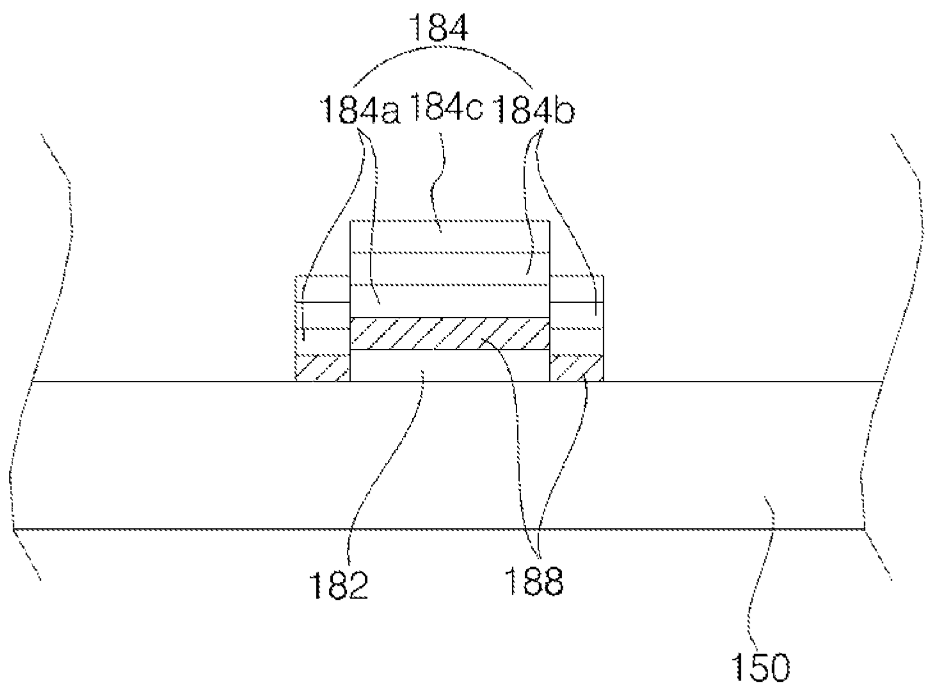


FIG. 20

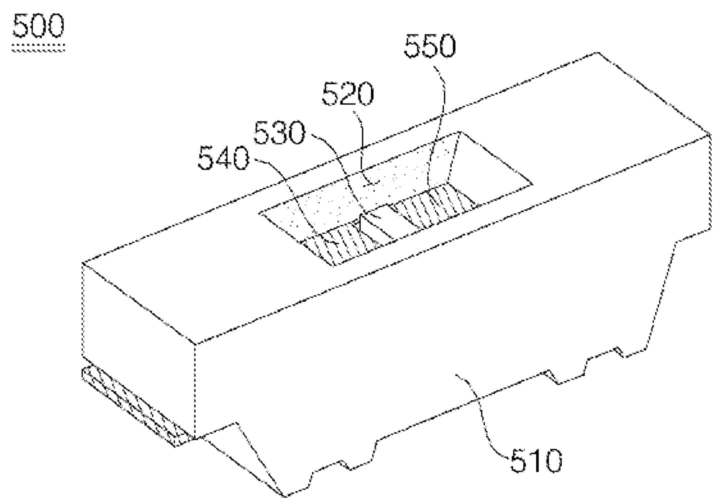


FIG. 21

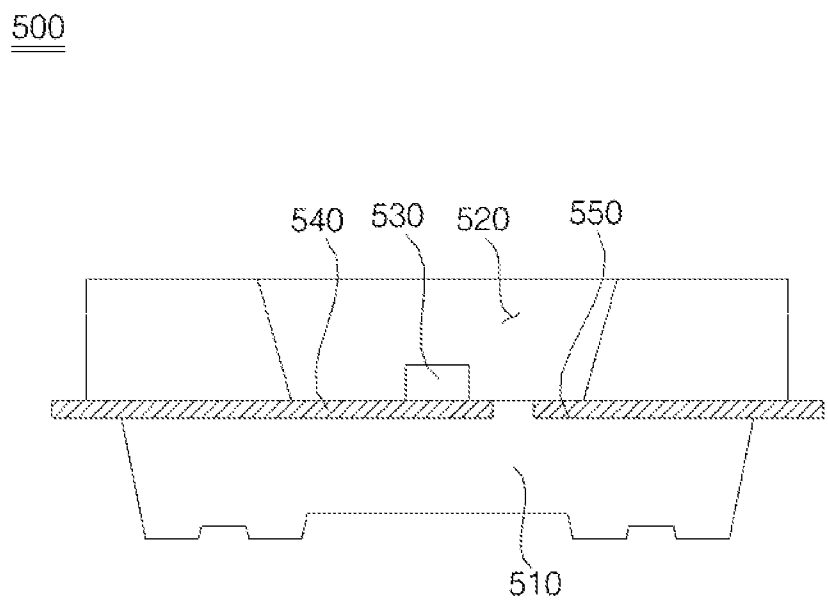


FIG. 22

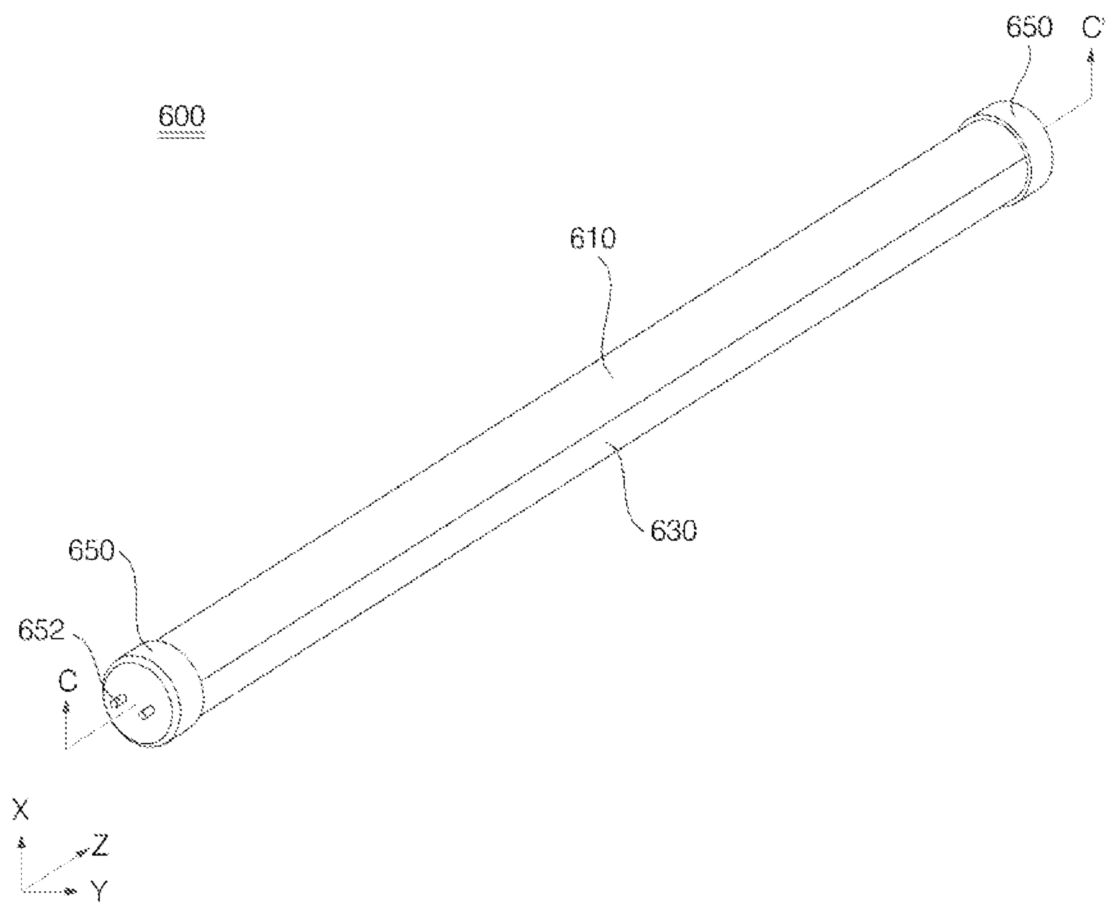


FIG. 23

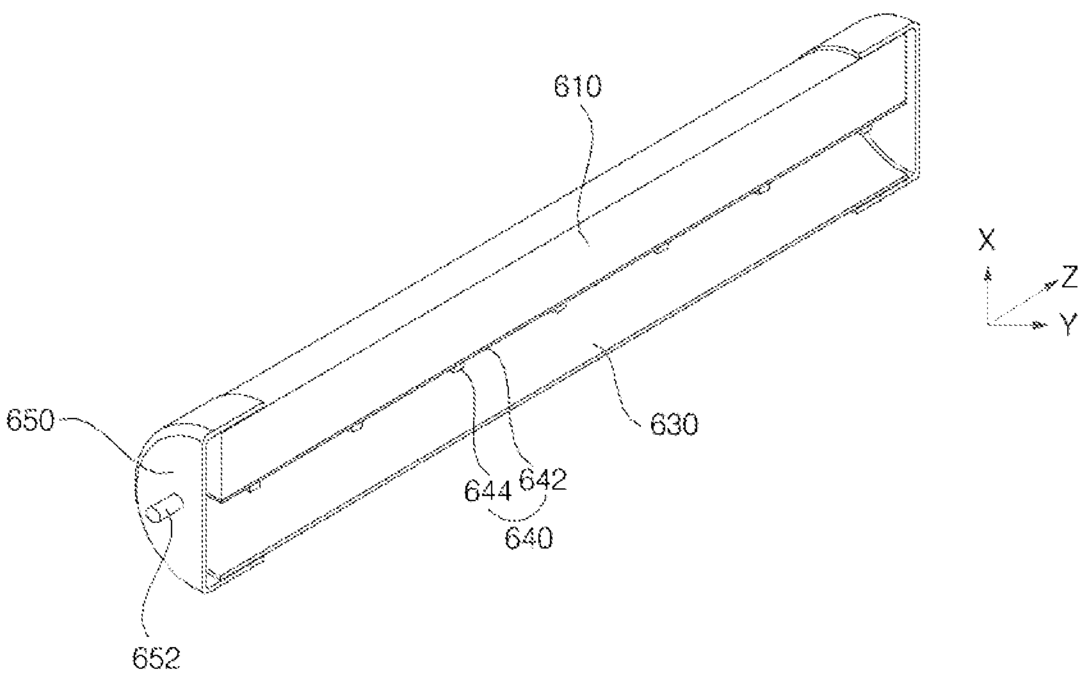


FIG. 24

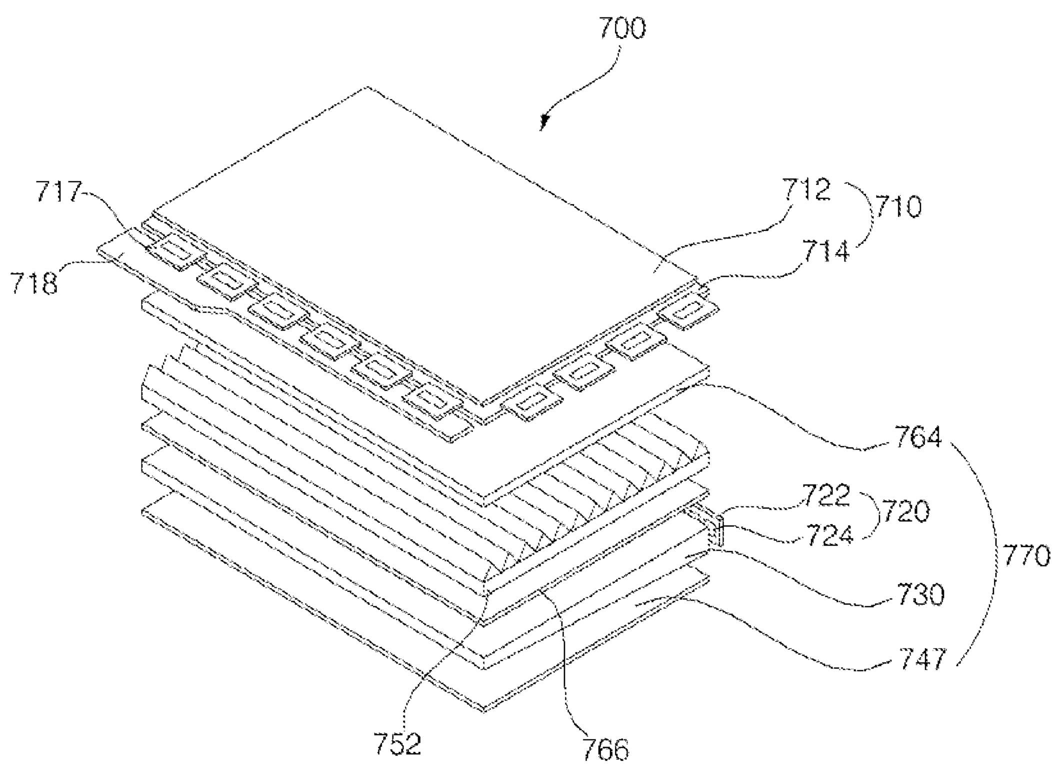
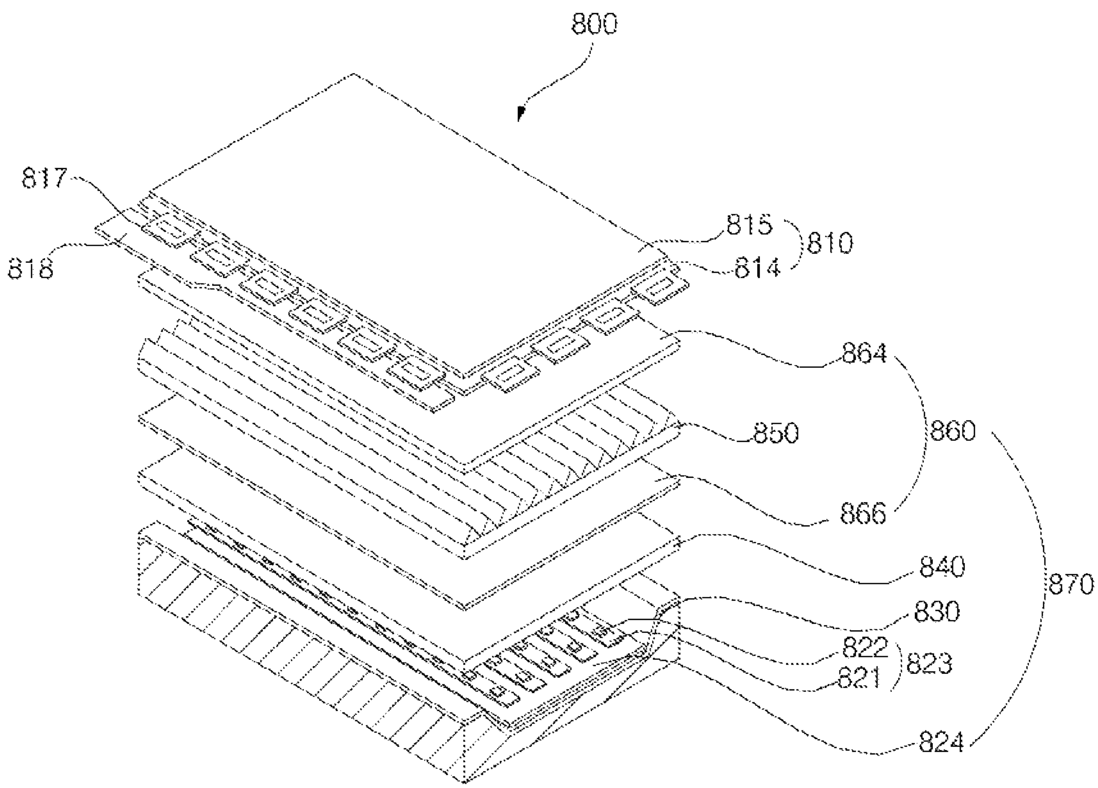


FIG. 25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LIGHT EMITTING DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a Continuation of co-pending U.S. patent application Ser. No. 13/412,786 filed Mar. 6, 2012, which claims priority to Korean Patent Application No. 10-2011-0119144, filed in the Republic of Korea on Nov. 15, 2011, the entire contents of all of the above applications are hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

Embodiments relate to a light emitting device.

2. Discussion of the Related Art

Light Emitting Diodes (LEDs) are representative of light emitting devices, and refer to devices which convert electrical signals into light such as infrared light or visible light using characteristics of compound semiconductors. Such LEDs are being utilized in home appliances, remote controllers, electronic displays, displays and various other automated machines, and the application range thereof is gradually increasing.

In General, miniature LEDs are fabricated into surface mount devices so as to be directly mounted on a Printed Circuit Board (PCB), and hence, LED lamps, which serve as display devices, are being developed into surface mount devices. The surface mount devices can substitute for conventional simple lamps and are used in a variety of color on-and-off displays and character displays and image displays.

As the application range of LEDs is broad, household lamps, distress signal lamps, or the like require high luminance. Therefore, luminance of the LEDs needs to be increased.

SUMMARY OF THE INVENTION

Embodiments provide a light emitting device including an electrode, which has a superior bonding property to a semiconductor layer and has high light reflectivity.

In one embodiment, a light emitting device includes a light emitting structure including a first semiconductor layer, a second semiconductor layer, and an active layer between the first and second semiconductor layers, a first electrode electrically connected to the first semiconductor layer, and a second electrode disposed over the second semiconductor layer, wherein the second electrode includes a reflective electrode layer disposed over the second semiconductor layer, and a bonding electrode layer disposed in at least a partial region of an outer side surface of the reflective electrode layer while coming into contact with the second semiconductor layer.

BRIEF DESCRIPTION OF THE DRAWINGS

Details of embodiments will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. **1** is a top view illustrating a light emitting device according to an exemplary embodiment;

FIG. **2** is a sectional view taken along line A-A of the light emitting device shown in FIG. **1**;

FIG. **3** is an enlarged view illustrating region "a" of FIG. **2**;

FIG. **4** is an enlarged view illustrating region "b" of FIG. **2**;

FIG. **5** is a sectional view illustrating an electrode of a light emitting device according to another embodiment;

FIG. **6** is a sectional view illustrating an electrode of a light emitting device according to a further embodiment;

FIG. **7** is a sectional view illustrating an electrode of a light emitting device according to yet another embodiment;

FIG. **8** is a sectional view illustrating an electrode of a light emitting device according to yet another embodiment;

FIG. **9** is a sectional view illustrating an electrode of a light emitting device according to yet another embodiment;

FIG. **10** is a sectional view illustrating an electrode of a light emitting device according to yet another embodiment;

FIG. **11** is a sectional view illustrating an electrode of a light emitting device according to yet another embodiment;

FIG. **12** is a sectional view illustrating an electrode of a light emitting device according to yet another embodiment;

FIG. **13** is a top view illustrating a light emitting device according to yet another embodiment;

FIG. **14** is a top view illustrating a light emitting device according to yet another embodiment;

FIG. **15** is a sectional illustrating a light emitting device according to yet another embodiment;

FIG. **16** is a sectional view illustrating a light emitting device according to yet another embodiment;

FIGS. **17** to **19** are sectional views illustrating sequential processes of a method for manufacturing the electrode of the light emitting device according to the illustrated embodiment;

FIG. **20** is a perspective view illustrating a light emitting device package including a light emitting device according to an exemplary embodiment;

FIG. **21** is a sectional view illustrating the light emitting device package including the light emitting device according to the illustrated exemplary embodiment;

FIG. **22** is a perspective view illustrating a lighting apparatus including a light emitting device according to an exemplary embodiment;

FIG. **23** is a sectional view taken along line C-C' of the lighting apparatus shown in FIG. **22**;

FIG. **24** is an exploded perspective view illustrating a liquid crystal display apparatus including a light emitting device according to an exemplary embodiment; and

FIG. **25** is an exploded perspective view illustrating a liquid crystal display apparatus including a light emitting device according to an exemplary embodiment.

DETAILED DESCRIPTION OF THE INVENTION

Reference will now be made in detail to embodiments, examples of which are illustrated in the accompanying drawings. However, the present disclosure may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein.

Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the disclosure to those skilled in the art. The present disclosure is defined only by the categories of the claims. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

Spatially-relative terms such as "below", "beneath", "lower", "above", or "upper" may be used herein to describe one element's relationship to another element as illustrated in the figures. It will be understood that spatially-relative terms are intended to encompass different orientations of the device in addition to the orientation depicted in the Figures. For example, if the device in one of the figures is turned over, elements described as "below" or "beneath" other elements would then be oriented "above" the other elements. The exemplary terms "below" or "beneath" can, therefore, encompass both an orientation of above and below. Since the device may be oriented in another direction, the spatially-relative terms may be interpreted in accordance with the orientation of the device.

The terminology used in the present disclosure is for the purpose of describing particular embodiments only and is not intended to limit the disclosure. As used in the disclosure and the appended claims, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and the present disclosure, and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

In the drawings, the thickness or size of each layer is exaggerated, omitted, or schematically illustrated for convenience of description and clarity. Also, the size or area of each constituent element does not entirely reflect the actual size thereof.

Angles or directions used to describe the structures of light emitting devices according to embodiments are based on those shown in the drawings. Unless there is, in the specification, no definition of a reference point to describe angular positional relations in the structures of the light emitting devices, the associated drawings may be referred to.

FIG. **1** is a top view illustrating a light emitting device according to an exemplary embodiment. FIG. **2** is a sectional view taken along line A-A of the light emitting device shown in FIG. **1**. FIG. **3** is an enlarged view illustrating region "a" of FIG. **2**. FIG. **4** is an enlarged view illustrating region "b" of FIG. **2**.

Referring to FIGS. **1** to **4**, the light emitting device, which is designated by reference numeral **100**, according to the illustrated embodiment may largely include a support member **110**, a light emitting structure, and an electrode. The light emitting structure may include a first semiconductor layer **120**, a second semiconductor layer **140**, and an active layer **130** between the first and second semiconductor layers **120** and **140**.

The support member **110** may be made of any one of materials having light transmittance, for example, sapphire (Al_2O_3), GAN, ZnO, and AlO, but the present disclosure is not limited thereto. Also, the support member **110** may be a support member made of silicon carbide (SiC) having higher thermal conductivity than the sapphire (Al_2O_3) support member. However, the support member **110** preferably has a lower refractive index than the first semiconductor layer **120** in order to enhance light extraction efficiency.

Meanwhile, the support member **110** may be formed, at a lower surface thereof, with a surface irregularity pattern to enhance light extraction efficiency.

The surface irregularity pattern may be formed at a surface opposed to the surface at which the light emitting structure is formed, and be formed using an etching method. For example, a dry etching method or a wet etching method may be used, but the present disclosure is not limited thereto. In accordance with the surface irregularity pattern, it may be possible to prevent total reflection of light, and thus to achieve an enhancement in light extraction efficiency.

Meanwhile, a buffer layer (not shown) may be disposed on the support member **110**, to reduce lattice misalignment between the support member **110** and the first semiconductor layer **120** while enabling easy growth of the semiconductor layer. The buffer layer (not shown) may be formed in a lower temperature mode, and be made of a material capable of reducing a difference in lattice constants between the semiconductor layer and the support member. For example, the buffer layer may be made of a material selected from GaN, InN, AlN, AlInN, InGaN, AlGaN, and InAlGaN, but the present disclosure is not limited thereto.

The light emitting structure, which includes the first semiconductor layer **120**, the active layer **130**, and the second semiconductor layer **140**, may be formed on the buffer layer (not shown).

The first semiconductor layer **120** may be disposed on the buffer layer (not shown). The first semiconductor layer **120** may be implemented as an n-type semiconductor layer, and may supply electrons to the active layer **130**. The first semiconductor layer **120** may be made of, for example, a semiconductor material having a formula of $In_xAl_yGa_{1-x-y}N$ ($0 \le x \le 1$, $0 \le y \le 1$, and $0 \le x+y \le 1$). For example, the first semiconductor layer **120** may be made of a semiconductor material selected from GaN, AlN, AlGaN, InGaN, InN, InAlGaN, AlInN, and the like, and may be doped with an n-type dopant such as Si, Ge, Sn, or the like.

The first semiconductor layer **120** may further include an undoped semiconductor layer (not shown) disposed beneath the first semiconductor layer **120**, but the present disclosure is not limited thereto. The undoped semiconductor layer refers to a layer formed to enhance crystalizability of the first semiconductor layer **120**, and is not doped with the n-type dopant. Accordingly, the undoped semiconductor layer may be equal to the first semiconductor layer **120**, except for having lower electrical conductivity than the first semiconductor layer **120**.

The active layer **130** may be formed on the first semiconductor layer **120**. The active layer **130** may have a single quantum well structure, a multi quantum well (MQW) structure, a quantum wire structure, a quantum dot structure, or the like, which is formed using a Group III-V compound semiconductor material.

When the active layer **130** has the quantum well structure, the active layer **130**, for example, may have the single or multi quantum well structure, which includes a well layer having a formula of $In_xAl_yGa_{1-x-y}N$ ($0 \le x \le 1$, $0 \le y \le 1$, and $0 \le x+y \le 1$) and a barrier layer having a formula of $In_aAl_bGa_{1-a-b}N$ ($0 \le a \le 1$, $0 \le b \le 1$, and $0 \le a+b \le 1$). The well layer may be made of a material having a band gap smaller than a band gap of the barrier layer.

A conductive clad layer (not shown) may be formed over and/or beneath the active layer **130**. The conductive clad layer (not shown) may be made of an AlGaN-based semiconductor and have a greater band gap than the active layer **130**.

The second semiconductor layer **140** may be implemented as a p-type semiconductor layer so as to inject holes into the active layer **130**. The second semiconductor layer **140** may be made of a semiconductor material having a formula of $In_xAl_yGa_{1-x-y}N$ ($0 \le x \le 1$, $0 \le y \le 1$, and $0 \le x+y \le 1$). For example, the second semiconductor layer **140** may be made of a semiconductor material selected from GaN, AlN, AlGaN, InGaN, InN, InAlGaN, AlInN, and the like, and may be doped with a p-type dopant such as Mg, Zn, Ca, Sr, Ba, or the like.

Meanwhile, an intermediate layer (not shown) may be formed between the active layer **130** and the second semiconductor layer **140**. The intermediate layer may be an electron blocking layer to prevent electrons injected from the first semiconductor layer **120** to the active layer **130** during application of high current from flowing to the second semiconductor layer **140**, without recombination of the electrons in the active layer **130**. The intermediate layer has a relatively greater band gap than the active layer **130**, thereby preventing electrons injected from the first semiconductor layer **120** from being injected into the second semiconductor layer **140**, without recombination of the electrons in the active layer **130**. Thus, it may be possible to enhance recombination probability between the electrons and the holes in the active layer **130** and to prevent leakage of current.

Here, the intermediate layer may have a greater band gap than the band gap of the barrier layer included in the active layer **130**, and be formed as a semiconductor layer containing aluminum (Al) such as p-type AlGaN. However, the intermediate layer is not limited to the above-mentioned configuration.

The above-mentioned first semiconductor layer **120**, active layer **130**, and second semiconductor layer **140** may be formed, for example, using metal organic chemical vapor deposition (MOCVD), chemical vapor deposition (CVD), plasma-enhanced chemical vapor deposition (PECVD), molecular beam epitaxy (MBE), hydride vapor phase epitaxy (HVPE), or sputtering, but the present disclosure is not limited thereto.

Also, the conductive dopant in each of the first and second semiconductor layers **120** and **140** may have a uniform or non-uniform doping concentration. That is, a plurality of semiconductor layers may be formed to have various doping concentration distributions, but the present disclosure is not limited thereto.

In addition, the first semiconductor layer **120** may be implemented as a p-type semiconductor layer, the second semiconductor layer **140** may be implemented as an n-type semiconductor layer, and a third semiconductor layer (not shown), which includes an n-type or p-type semiconductor layer, may also be formed on the second semiconductor layer **140**. Thus, the light emitting device **100** may have at least one of an n-p junction structure, a p-n junction structure, an n-p-n junction structure, and a p-n-p junction structure.

The electrode serves to connect the light emitting device **100** to a power source. The electrode may include a first electrode **170** electrically connected to the first semiconductor layer **120** and a second electrode **180** disposed over the second semiconductor layer **140**. A light transmitting electrode layer **150** may be formed between the second electrode **180** and the second semiconductor layer **140**.

The light transmitting electrode layer **150** may be made of at least one of ITO, IZO(In—ZnO), GZO(Ga—ZnO), AZO (Al—ZnO), AGZO(Al—GaZnO), IGZO(In—GaZnO), IrO_x, RuO_x, RuO_x/ITO, Ni/IrO_x/Au, and Ni/IrO_x/Au/ITO. The light transmitting electrode layer **150** may be formed throughout one surface of an outer side of the second semiconductor layer **140**, thereby preventing a current crowding phenomenon.

The first electrode **170** may be formed on the first semiconductor layer **120**. The first electrode **170** is not limited to a formation position thereof, and a plurality of first electrodes may also be formed, taking into consideration a size or the like of the light emitting device **100**. Furthermore, partial regions of the second semiconductor layer **140** and active layer **130** are removed, a portion of the first semiconductor layer **120** is exposed, and the first electrode **170** may be formed on the exposed upper surface of the first semiconductor layer **120**, as shown in FIG. **2**. However, the present disclosure is not limited to the above-mentioned configuration. For example, the support member **110** is removed, and the first electrode **170** may also be formed on the exposed surface of the first semiconductor layer **120**.

The first semiconductor layer **120** is not limited to a method removing the upper surface thereof, and, for example, a wet etching method, a dry etching method, and the like may be used.

The second electrode **180** may be disposed over the second semiconductor layer **140**.

Again referring to FIGS. **1** to **3**, the second electrode **180** may include a reflective electrode layer **182** disposed over the second semiconductor layer **140**, and a bonding electrode layer **188**, which is disposed in at least a partial region of an outer side surface of the reflective electrode layer **182** while coming into contact with the second semiconductor layer **140**.

The reflective electrode layer **182** may be connected to the second semiconductor layer **140**. When viewed from the top, the reflective electrode layer **182** may have various shapes such as a circular shape, a triangular shape, a square shape, and the like. Although the reflective electrode layer **182** is illustrated as having a circular shape in FIG. **1**, the present disclosure is not limited thereto. In addition, the reflective electrode layer **182** may have a stepped or inclined form in section. However, the reflective electrode layer **182** is not limited to the above-mentioned configuration, and the description thereof will be given later.

The reflective electrode layer **182** may contain a metal exhibiting a reflective material. For example, the reflective electrode layer **182** may contain any one selected from the group consisting of aluminum (Al), rhodium (Rh), tin (Sn), silver (Ag), a silver-based alloy, and a silver-based oxide. Also, the reflective electrode layer **182** may have a single layer structure or a multi layer structure, but the present disclosure is not limited thereto.

The bonding electrode layer **188** may be connected, at a lower surface thereof, to the second semiconductor layer **140**, and be disposed at the partial region of or throughout the outer side surface of the reflective electrode layer **182**. That is, the bonding electrode layer **188** may be formed to enclose a portion of or throughout the outer side surface of the reflective electrode layer **182**, and the lower surface of the bonding electrode layer **188** may be formed to come into contact with the second semiconductor layer **140**. The bonding electrode layer **188** is not limited to a shape thereof, and, for example, may have various shapes. The description thereof will be given later.

The bonding electrode layer **188** may have a single layer structure or a multi layer structure, and may contain a material having a superior bonding force to the second semiconductor layer **140**. For example, the bonding electrode layer **188** may contain any one of chromium (Cr) and titanium (Ti), but the present disclosure is not limited thereto.

The bonding electrode layer **188** may have the multi layer structure, and at least, for example, a chromium (Cr) layer, an aluminum (Al) layer, a nickel (Ni) layer, and a gold (Au) layer are laminated on the bonding electrode layer **188** in this order. The Cr layer may be disposed to come into contact with an upper surface of the second semiconductor layer **140**. Also, the layers may be repeatedly laminated in the above-mentioned order. Although the bonding electrode layer **188** is not limited to a thickness thereof, the Cr layer may have a thickness of 15 Å to 25 Å, the Al layer may have a thickness of 2800 Å to 3200 Å, the Ni layer may have a thickness of 400 Å to 600 Å, and the Au layer may have a thickness of 7500 Å to 8500 Å. Since, A heat treatment process is proceeded after Al is laminated and Cr (conventional electrode) is laminated after the heat treatment process, it may be possible to enhance reflectivity of electrode, thereby enhancing light extraction efficiency of the light emitting device. Since the workfunction of Al is 4.28 and the workfunction of Cr is 4.5, it may be possible to achieve an enhancement in electrical characteristics.

As such, when the reflective electrode layer **182** is disposed and the bonding electrode layer **188** is disposed at the outer side surface of the reflective electrode layer **182**, it may be possible to prevent peeling-off of the reflective electrode layer **182** due to weak bonding force between the second semiconductor layer **140** and the reflective electrode layer **182**. At the same time, since light emitted from the active layer **130** is reflected by the reflective electrode layer **182**, it may be possible to prevent light absorption by virtue of the second electrode **180**.

The above-mentioned description will be given again with reference to Table 1 below. The following Table 1 represents a result with respect to a reflectivity experiment between the conventional electrode and the electrode according to the illustrated embodiment. The conventional electrode has a structure in which a bonding electrode layer, a reflective electrode layer, and an anti-oxidation layer are laminated in this order. On the other hand, Example 1 refers to an electrode structure according to the illustrated embodiment, and the case in which a width ratio of the reflective electrode layer **182** to the bonding electrode layer **188** is 10:1. Example 2 refers to an electrode structure according to the illustrated embodiment, and the case in which a width ratio of the reflective electrode layer **182** to the bonding electrode layer **188** is 10:4. In accordance with this result, it may be possible to achieve an enhancement in reflectivity of about 5% or more through the electrode structure of the light emitting device **100** according to the illustrated embodiment while maintaining bonding force between the electrode and the semiconductor layer.

TABLE 1

	Reflectivity (%) (at 450 nm)
Conventional Art	84.45
Example 1	89.60
Example 2	88.58

Meanwhile, the bonding electrode layer **188** may have a width and a thickness capable of enclosing the outer side surface of the reflective electrode layer **182**.

When the bonding electrode layer **188** has an overly thick thickness h1, an area capable of absorbing light emitted from the active layer **130** is increased, whereas when the bonding electrode layer **188** has an overly thin thickness h1, bonding force between the reflective electrode layer **182** and the bonding electrode layer **188** is deteriorated. Therefore, the bonding electrode layer **188** may have a thickness of 300 nm to 500 nm. Alternatively, the thickness h1 of the bonding electrode layer **188** may be 0.2 to 1 times the thickness h2 of the reflective electrode layer **182**, but the present disclosure is not limited thereto.

When the bonding electrode layer **188** has an overly high width w1, an area capable of absorbing light emitted from the active layer **130** is increased, whereas when the bonding electrode layer **188** has an overly small width w1, bonding force between the reflective electrode layer **182** and the second semiconductor layer **140** is deteriorated. Therefore, the bonding electrode layer **188** may have a width of 1 μm to 2 μm. Alternatively, the width w1 of the bonding electrode layer **188** may be 0.1 to 0.5 times the width w2 of the reflective electrode layer **182**, but the present disclosure is not limited thereto.

Again referring to FIG. **4**, the first electrode **170** may include a reflective electrode layer **172** disposed on the first semiconductor layer **120**, and a bonding electrode layer **178**, which is disposed in at least a partial region of an outer side surface of the reflective electrode layer **172** while coming into contact with the first semiconductor layer **120**.

The reflective electrode layer **172** may be connected to the first semiconductor layer **120**. When viewed from the top, the reflective electrode layer **172** may have various shapes such as a circular shape, a triangular shape, a square shape, and the like. Although the reflective electrode layer **172** is illustrated as having a circular shape in FIG. **1**, the present disclosure is not limited thereto. In addition, the reflective electrode layer **172** may have a stepped or inclined form in section. However, the reflective electrode layer **172** is not limited to the above-mentioned configuration, and the description thereof will be given later.

The reflective electrode layer **172** may contain a metal exhibiting a reflective material. For example, the reflective electrode layer **172** may contain any one selected from the group consisting of aluminum (Al), rhodium (Rh), tin (Sn), silver (Ag), a silver-based alloy, and a silver-based oxide. Also, the reflective electrode layer **172** may have a single layer structure or a multi layer structure, but the present disclosure is not limited thereto.

The bonding electrode layer **178** may be connected, at a lower surface thereof, to the first semiconductor layer **120**, and be disposed at the partial region of or throughout the outer side surface of the reflective electrode layer **172**. That is, the bonding electrode layer **178** may be formed to enclose a portion of or throughout the outer side surface of the reflective electrode layer **172**, and the lower surface of the bonding electrode layer **178** be formed to come into contact with the first semiconductor layer **120**. The bonding electrode layer **178** is not limited to a shape thereof, and, for example, may have various shapes. The description thereof will be given later.

The bonding electrode layer **178** may contain a material having a superior bonding force to the first semiconductor layer **120**. For example, the bonding electrode layer **178** may contain any one of chromium (Cr) and titanium (Ti), but the present disclosure is not limited thereto.

As such, when the reflective electrode layer **172** is disposed and the bonding electrode layer **178** is disposed at the outer side surface of the reflective electrode layer **172**, it may be possible to prevent peeling-off of the reflective electrode layer **172** due to weak bonding force between the first semiconductor layer **120** and the reflective electrode layer **172**. At the same time, since light emitted from the active layer **130** is reflected by the reflective electrode layer **172**, it may be possible to prevent light absorption by virtue of the first electrode **170**.

Meanwhile, the bonding electrode layer **178** may have a width and a thickness capable of enclosing the outer side surface of the reflective electrode layer **172**.

When the bonding electrode layer **178** has an overly thick thickness h1, an area capable of absorbing light emitted from the active layer **130** is increased, whereas when the bonding electrode layer **178** has an overly thin thickness h1, bonding force between the reflective electrode layer **172** and the bonding electrode layer **178** is deteriorated. Therefore, the bonding electrode layer **178** may have a thickness of 300 nm to 500 nm. Alternatively, the thickness h1 of the bonding electrode layer **178** may be 0.2 to 1 times the thickness h2 of the reflective electrode layer **172**, but the present disclosure is not limited thereto.

When the bonding electrode layer **178** has an overly high width w1, an area capable of absorbing light emitted from the active layer **130** is increased, whereas when the bonding electrode layer **178** has an overly small width w1, bonding force between the reflective electrode layer **172** and the first semiconductor layer **120** is deteriorated. Therefore, the bonding electrode layer **178** may have a width of 1 μm to 2 μm. Alternatively, the width w1 of the bonding electrode layer **178** may be 0.1 to 0.5 times the width w2 of the reflective electrode layer **172**, but the present disclosure is not limited thereto.

Hereinafter, the following description will be given in conjunction with the second electrode **180**. Since the first electrode **170** is similar to the second electrode **180**, unless otherwise specifically mentioned, no description will be given thereof.

FIG. **5** is a sectional view illustrating an electrode of a light emitting device according to another embodiment.

Referring to FIG. **5**, the light emitting device, which is designated by reference numeral **100**, according to the illustrated embodiment includes a first electrode **170** and a second electrode **180** having a different structure than the embodiment illustrated in FIG. **1**.

The second electrode **180** may include a reflective electrode layer **182** and a bonding electrode layer **188**, and the reflective electrode layer **182** may have a decreasing width with decreasing distance to an upward direction. That is, the reflective electrode layer **182** may have an inclined surface at a side surface thereof. In this case, the bonding electrode layer **188** may be formed along the inclined surface of the reflective electrode layer **182**.

As such, when the reflective electrode layer **182** has the decreasing width with decreasing distance to the upward direction, an area to reflect light emitted from the active layer **130** may be increased and bonding force between the reflective electrode layer **182** and the bonding electrode layer **188** may be increased. Thus, it may further be possible to prevent peeling-off of the reflective electrode layer **182** from the semiconductor layer.

The first electrode **170** may have the same structure as the second electrode **180**.

FIG. **6** is a sectional view illustrating an electrode of a light emitting device according to a further embodiment.

Referring to FIG. **6**, the light emitting device, which is designated by reference numeral **100**, according to the illustrated embodiment includes a first electrode **170** and a second electrode **180** having a different structure than the embodiment illustrated in FIG. **1**.

The second electrode **180** may include a reflective electrode layer **182** and a bonding electrode layer **188**. The reflective electrode layer **182** may include a first reflective electrode layer **182*a*** formed to have a height equal to the bonding electrode layer **188** and a second reflective electrode layer **182*b***, which is disposed on the first reflective electrode layer **182*a*** while having a width smaller than the first reflective electrode layer **182*a***. The bonding electrode layer **188** may be disposed from a side surface of the first reflective electrode layer **182*a*** along an upper surface of the first reflective electrode layer **182*a*** up to a partial region of a side surface of the second reflective electrode layer **182*b***. That is, the reflective electrode layer **182** may have a stepped form at the side surface thereof, and the bonding electrode layer **188** may be formed along the stepped form of the reflective electrode layer **182**.

Thus, an area to reflect light emitted from the active layer **130** may be increased, and a contact area between the reflective electrode layer **182** and the bonding electrode layer **188** may be increased. Consequently, it may further be possible to prevent peeling-off of the reflective electrode layer **182** from the semiconductor layer.

The first electrode **170** may have the same structure as the second electrode **180**.

FIG. **7** is a sectional view illustrating an electrode of a light emitting device according to yet another embodiment.

Referring to FIG. **7**, the light emitting device, which is designated by reference numeral **100**, according to the illustrated embodiment includes a first electrode **170** and a second electrode **180** having a different structure than the embodiment illustrated in FIG. **1**.

The second electrode **180** may include a reflective electrode layer **182** and a bonding electrode layer **188**, and may further include a protective layer **183** disposed on the reflective electrode layer **182** and/or the bonding electrode layer **188**.

The protective layer **183** may contain nickel (Ni).

FIG. **8** is a sectional view illustrating an electrode of a light emitting device according to yet another embodiment.

Referring to FIG. **8**, the light emitting device, which is designated by reference numeral **100**, according to the illustrated embodiment includes a first electrode **170** and a second electrode **180** having a different structure than the embodiment illustrated in FIG. **1**.

The second electrode **180** may include a reflective electrode layer **182** and a bonding electrode layer **188**, and may further include an anti-oxidation electrode layer **184** disposed on the reflective electrode layer **182** and/or the bonding electrode layer **188**.

The anti-oxidation electrode layer **184** is not limited to a shape thereof, and may be disposed to be vertically overlapped with the reflective electrode layer **182** and bonding electrode layer **188**. The anti-oxidation electrode layer **184** serves to prevent oxidation of the reflective electrode layer **182** and bonding electrode layer **188**.

The anti-oxidation electrode layer **184** may contain a conductive material having oxidation resistance. For example, the anti-oxidation electrode layer **184** may contain at least one of gold (Au), rhodium (Rh), palladium (Pd), copper (Cu), nickel (Ni), ruthenium (Ru), iridium (Ir), and platinum (Pt), but the present disclosure is not limited thereto.

FIG. **9** is a sectional view illustrating an electrode of a light emitting device according to yet another embodiment.

Referring to FIG. **9**, the light emitting device, which is designated by reference numeral **100**, according to the illustrated embodiment includes a first electrode **170** and a second electrode **180** having a different structure than the embodiment illustrated in FIG. **1**.

The second electrode **180** may include a reflective electrode layer **182** and a bonding electrode layer **188**. The reflective electrode layer **182** may include a first reflective electrode layer **182*a*** formed to have a height equal to the bonding electrode layer **188** and a second reflective electrode layer **182*b***, which is disposed on the first reflective electrode layer **182*a*** while being disposed up to an upper surface of the first reflective electrode layer **182*a***. Also, the second electrode **180** may further include an anti-oxidation electrode layer **184** disposed on the second reflective electrode layer **182*b***.

The anti-oxidation electrode layer **184** is not limited to a shape thereof, and may be disposed to be vertically overlapped with the reflective electrode layer **182** and bonding electrode layer **188**. The anti-oxidation electrode layer **184** serves to prevent oxidation of the reflective electrode layer **182** and bonding electrode layer **188**.

The anti-oxidation electrode layer **184** may contain a conductive material having oxidation resistance. For example, the anti-oxidation electrode layer **184** may contain at least one of gold (Au), rhodium (Rh), palladium (Pd), copper (Cu), nickel (Ni), ruthenium (Ru), iridium (Ir), and platinum (Pt), but the present disclosure is not limited thereto.

FIG. **10** is a sectional view illustrating an electrode of a light emitting device according to yet another embodiment.

Referring to FIG. **10**, the light emitting device, which is designated by reference numeral **100**, according to the illustrated embodiment includes a second reflective electrode layer **182***b* having a different structure than the embodiment illustrated in FIG. **9**.

The second reflective electrode layer **182***b* may be disposed to extend from an upper surface of the bonding electrode layer **188** to a side surface of the bonding electrode layer **188**.

Referring to FIG. **11**, a light emitting device, which is designated by reference numeral **100**, according to an illustrated embodiment includes a first electrode **170** and a second electrode **180** having a different structure than the embodiment illustrated in FIG. **1**.

The second electrode **180** may include a reflective electrode layer **182** and a bonding electrode layer **188**, and the bonding electrode layer **188** may have a greater height than the reflective electrode layer **182**. Also, the bonding electrode layer **188** may be disposed to extend from a side surface of the reflective electrode layer **182** to an upper surface of the reflective electrode layer **182**. That is, the bonding electrode layer **188** may include a first bonding electrode layer **188***a* disposed at the side surface of the reflective electrode layer **182** and a second bonding electrode layer **188***b* disposed on the reflective electrode layer **182**.

In this case, the reflective electrode layer **182** may have a thickness of 200 nm to 500 nm.

The second electrode **180** may further include an anti-oxidation electrode layer **184** disposed on the second bonding electrode layer **188***b*.

The anti-oxidation electrode layer **184** is not limited to a shape thereof, and serves to prevent oxidation of the reflective electrode layer **182** and bonding electrode layer **188**.

The anti-oxidation electrode layer **184** may contain a conductive material having oxidation resistance. For example, the anti-oxidation electrode layer **184** may contain at least one of gold (Au), rhodium (Rh), palladium (Pd), copper (Cu), nickel (Ni), ruthenium (Ru), iridium (Ir), and platinum (Pt), but the present disclosure is not limited thereto.

The anti-oxidation electrode layer **184** illustrated in FIG. **11** may include a first anti-oxidation electrode layer **184***a* made of nickel (Ni) or the like, and a second anti-oxidation electrode layer **184***b*, which is made of gold (Au) or the like and is disposed on the first anti-oxidation electrode layer **184***a*.

Here, the first anti-oxidation electrode layer **184***a* may have a thickness of 400 Å to 600 Å, and the second anti-oxidation electrode layer **184***b* may have a thickness of 7500 Å to 8500 Å. However, the present disclosure is not limited to the above-mentioned configuration.

The first electrode **170** may have the same structure as the second electrode **180**.

FIG. **12** is a sectional view illustrating an electrode of a light emitting device according to yet another embodiment.

Referring to FIG. **12**, a reflective electrode layer **182** may have a multi layer structure, and may have a structure in which, for example, at least an aluminum (Al) layer **182-1**, a nickel (Ni) layer **182-2**, and a gold (Au) layer **182-3** are laminated in this order. The Al layer **182-1** may be disposed to come into contact with the upper surface of the second semiconductor layer **140**. In addition, the reflective electrode layer **182** may have a structure in which the Al layer **182-1**, the Ni layer **182-2**, and the Au layer **182-3** are laminated in this order, and may further include a chromium (Cr) layer **182-4**, an aluminum (Al) layer **182-5**, a nickel (Ni) layer **182-6**, and a gold (Au) layer **182-7** disposed on the Au layer **182-3**. However, the present disclosure is not limited to the above-mentioned configuration.

Although each layer is not limited to a thickness thereof, the Al layer **182-1** may have a thickness of 2800 Å to 3200 Å, the Ni layer **182-2** may have a thickness of 400 Å to 600 Å, the Au layer **182-3** may have a thickness of 7500 Å to 8500 Å, and the Cr layer **182-4** may have a thickness of 15 Å to 25 Å.

A bonding electrode layer **188** may have a multi layer structure, and may have a structure in which, for example, at least a chromium (Cr) layer **188-1**, an aluminum (Al) layer **188-2**, a nickel (Ni) layer **188-3**, and a gold (Au) layer **188-4** are laminated in this order. The Cr layer **188-1** may be disposed to come into contact with the upper surface of the second semiconductor layer **140**. Also, the layers may be repeatedly laminated in the above-mentioned order. Although the bonding electrode layer **188** is not limited to a thickness thereof, the Cr layer **188-1** may have a thickness of 15 Å to 25 Å, the Al layer **188-2** may have a thickness of 2800 Å to 3200 Å, the Ni layer **188-3** may have a thickness of 400 Å to 600 Å, and the Au layer **188-4** may have a thickness of 7500 Å to 8500 Å.

FIG. **13** is a top view illustrating a light emitting device according to yet another embodiment.

Referring to FIG. **13**, the light emitting device, which is designated by reference numeral **200**, according to the illustrated embodiment includes a first electrode **270** and a second electrode **280** having a different structure than the embodiment illustrated in FIG. **1**.

The second electrode **280** may include a reflective electrode layer **282** and a bonding electrode layer **288** enclosing a partial region of an outer side surface of the reflective electrode layer **282**. Although the bonding electrode layer **288** is illustrated as being divided into four segments in FIG. **13**, the present disclosure is not limited thereto. For example, the bonding electrode layer **288** may have a plurality of segments.

The first electrode **270** may have the same structure as the second electrode **280**.

FIG. **14** is a top view illustrating a light emitting device according to yet another embodiment.

Referring to FIG. **14**, the light emitting device, which is designated by reference numeral **300**, according to the illustrated embodiment includes a first electrode **370** and a second electrode **380** having a different structure than the embodiment illustrated in FIG. **1**.

The first electrode **370** may include a first electrode pad **375** disposed at one side on a first semiconductor layer **320** and at least one first electrode wing **376** connected to the first electrode pad **375** so as to be disposed at the other side of the first semiconductor layer **320**. However, the present disclosure is not limited to the above-mentioned configuration.

The second electrode **380** may include a second electrode pad **385** disposed at one side over a second semiconductor layer **340** and at least one second electrode wing **386** connected to the second electrode pad **385** so as to be disposed at the other side of the second semiconductor layer **340**. However, the present disclosure is not limited to the above-mentioned configuration.

FIG. **15** is a sectional illustrating a light emitting device according to yet another embodiment.

Referring to FIG. **15**, the light emitting device, which is designated by reference numeral **100**A, according to the illustrated embodiment includes a light transmitting electrode layer **150**A having a different structure than the embodiment illustrated in FIG. **2**.

The light transmitting electrode layer **150**A may include a via hole contacting directly between a second electrode **180** and a second semiconductor layer **140**.

FIG. **16** is a sectional view illustrating a light emitting device according to yet another embodiment.

Referring to FIG. **16**, the light emitting device, which is designated by reference numeral **400**, according to the illustrated embodiment may include a support member **410**, a light emitting structure including a first electrode layer **470**, a first semiconductor layer **420**, an active layer **430**, and a second semiconductor layer **440**, which are disposed over the support member **410**, and a second electrode **480**.

The support member **410** may be made of a material having superior thermal conductivity, or alternatively made of a conductive material. For example, the support member **410** may be formed using a metal material or conductive ceramics. The support member **410** may have a single layer structure. Alternatively, the support member **410** may have a double layer structure or a multilayer structure having three or more layers.

That is, the support member **410** is made of a metal, for example, any one selected from the group consisting of gold (Au), nickel (Ni), tungsten (W), molybdenum (Mo), copper (Cu), aluminum (Al), tantalum (Ta), silver (Ag), platinum (Pt), and chromium (Cr), or made of an alloy containing two or more materials. Also, the support member **410** may be formed by laminating two or more layers of different materials. Furthermore, the support member **410** may be formed using a carrier wafer, such as Si, Ge, GaAs, ZnO, SiC, SiGe, GaN, or Ga_2O_3. Such a support member **410** functions to easily dissipate heat generated from the light emitting device **400**, and thus to achieve an enhancement in thermal stability.

Meanwhile, the first electrode layer **470** may be formed on the support member **410**. The first electrode layer **470** may include at least one layer of an ohmic layer (not shown), a reflective layer (not shown), and a bonding layer (not shown). Although the first electrode layer **470**, for example, may have a structure of ohmic layer/reflective layer/bonding layer, a structure of ohmic layer/reflective layer, or a structure of reflective layer (including ohmic characteristics)/bonding layer, the present disclosure is not limited thereto. For example, the first electrode layer **470** may have a structure in which the reflective layer and the ohmic layer are sequentially laminated over the bonding layer.

The reflective layer (not shown) may be disposed between the ohmic layer (not shown) and the bonding layer (not shown). The reflective layer may be made of a material having high reflective characteristics. The reflective layer may be made of, for example. Ag, Ni, Al, Rh, Pd, Ir, Ru, Mg, Zn, Pt, Au, or Hf, or a selective combination thereof. Alternatively, the reflective layer may be formed to have a multilayer structure, using the metal materials and a light transmitting conductive material such as IZO, IZTO, IAZO, IGZO, IGTO, AZO, ATO, or the like. The reflective layer (not shown) may have a lamination structure of IZO/Ni, AZO/Ag, IZO/Ag/Ni, AZO/Ag/Ni, or the like. When the reflective layer (not shown) is made of a material coming into ohmic contact with the light emitting structure (for example, the first semiconductor layer **420**), the ohmic layer (not shown) may not be separately formed, but the present disclosure is not limited thereto.

The ohmic layer (not shown) may come into ohmic contact with a lower surface of the light emitting structure, and be formed to have a layer or a plurality of patterns. For the ohmic layer, a light transmitting electrode layer or a metal may be selectively used. For example, the ohmic layer may be implemented as a single layer structure or a multilayer structure, using at least one of indium tin oxide (ITO), indium zinc oxide (IZO), indium zinc tin oxide (IZTO), indium aluminum zinc oxide (IAZO), indium gallium zinc oxide (IGZO), indium gallium tin oxide (IGTO), aluminum zinc oxide (AZO), antimony tin oxide (ATO), gallium zinc oxide (GZO), IrO_x, RuO_x, RuO_x/ITO, Ni, Ag, Ni/IrO_x/Au, and Ni/IrO_x/Au/ITO. The ohmic layer (not shown) serves to smoothly inject carriers into the first semiconductor layer **420**, but it may not be necessary to form the ohmic layer.

The first electrode layer **470** may include the bonding layer (not shown). In this case, the bonding layer (not shown) may include a barrier metal or a bonding metal. For example, the bonding layer may contain at least one of Ti, Au, Sn, Ni, Cr, Ga, In, Bi, Cu, Ag, and Ta, but the present disclosure is not limited thereto.

The light emitting structure may include at least the first semiconductor layer **420**, the active layer **430**, and the second semiconductor layer **440**. The active layer **430** may be interposed between the first semiconductor layer **420** and the second semiconductor layer **440**.

The first semiconductor layer **420** may be formed on the first electrode layer **470**. The first semiconductor layer **420** may be implemented as a p-type semiconductor layer doped with a p-type dopant. The p-type semiconductor layer may be made of a semiconductor material having a formula of $In_xAl_yGa_{1-x-y}N$ ($0 \le x \le 1$, $0 \le y \le 1$, and $0 \le x+y \le 1$). For example, the p-type semiconductor layer may be made of a semiconductor material selected from GaN, AlN, AlGaN, InGaN, InN, InAlGaN, AlInN, and the like, and may be doped with a p-type dopant such as Mg, Zn, Ca, Sr, Ba, or the like.

The active layer **430** may be formed on the first semiconductor layer **420**. The active layer **430** may be formed to have a single quantum well structure, a multi quantum well (MQW) structure, a quantum wire structure, a quantum dot structure, or the like, using a Group III-V compound semiconductor material.

When the active layer **430** has the quantum well structure, the active layer **430**, for example, may have the single or multi quantum well structure, which includes a well layer having a formula of $In_xAl_yGa_{1-x-y}N$ ($0 \le x \le 1$, $0 \le y \le 1$, and $0 \le x+y \le 1$) and a barrier layer having a formula of $In_aAl_bGa_{1-a-b}N$ ($0 \le a \le 1$, $0 \le b \le 1$, and $0 \le a+b \le 1$). The well layer may be made of a material having a band gap smaller than a band gap of the barrier layer.

Also, when the active layer **430** has the multi quantum well structure, each well layer (not shown) may have a different indium (In) content and band gap, and the description thereof will be given with reference to FIGS. **8** to **10** later.

A conductive clad layer (not shown) may be formed over and/or beneath the active layer **430**. The conductive clad layer (not shown) may be made of an AlGaN-based semiconductor and have a greater band gap than the active layer **430**.

Meanwhile, an intermediate layer (not shown) may be formed between the active layer **430** and the first semiconductor layer **420**. The intermediate layer may be an electron blocking layer to prevent electrons injected from the second semiconductor layer **440** to the active layer **430** during application of high current from flowing to the first semiconductor layer **420**, without recombination of the electrons in the active layer **430**. The intermediate layer (not shown) has a relatively greater band gap than the active layer **430**, thereby preventing electrons injected from the second semiconductor layer **440** from being injected into the first semiconductor layer **420**, without recombination of the electrons in the active layer **430**. Thus, it may be possible to enhance recombination probability between the electrons and the holes in the active layer **430** and to prevent leakage of current.

Here, the intermediate layer may have a greater band gap than the band gap of the barrier layer included in the active layer **430**, and be formed as a semiconductor layer containing Al such as AlGaN. However, the intermediate layer is not limited to the above-mentioned configuration.

The second semiconductor layer **440** may be formed on the active layer **430**. The second semiconductor layer **440** may be implemented as an n-type semiconductor layer. The n-type semiconductor layer may be made of, for example, a semiconductor material having a formula of $In_xAl_yGa_{1-x-y}N$ ($0 \leq x \leq 1$, $0 \leq y \leq 1$, and $0 \leq x+y \leq 1$). For example, the n-type semiconductor layer may be made of a semiconductor material selected from GaN, AlN, AlGaN, InGaN, InN, InAlGaN, AlInN, and the like, and may be doped with an n-type dopant such as Si, Ge, Sn, or the like.

Meanwhile, the light emitting structure may include a third semiconductor layer (not shown), which is disposed on the second semiconductor layer **440**, having an opposite polarity to the second semiconductor layer **440**. Alternatively, the first semiconductor layer **420** may be implemented as an n-type semiconductor layer, and the second semiconductor layer **440** may be implemented as a p-type semiconductor layer. Thus, the light emitting structure may have at least one of an n-p junction structure, a p-n junction structure, an n-p-n junction structure, and a p-n-p junction structure.

The light emitting structure may be formed, at an upper portion thereof, with a light extraction structure (not shown).

The light extraction structure may be formed at a partial region of or throughout an upper surface of the second semiconductor layer **440**. The light extraction structure may be formed by carrying out an etching process upon at least a partial region of an upper surface of the second semiconductor layer **440** or light transmitting electrode layer (not shown), but the present disclosure is not limited thereto. The etching process may include a wet etching process and/or a dry etching process. According to carrying out the etching process, the upper surface of the second semiconductor layer **440** or light transmitting electrode layer (not shown) may be formed with a roughness having the light extraction structure. The roughness may be irregularly formed in a random size, but the present disclosure is not limited thereto. The roughness refers to an uneven surface, may include at least one of a texture pattern, an irregularity pattern, and an uneven pattern.

The roughness may be formed, at a lateral section thereof, to have various shapes such as a circular prism shape, a polygonal prism shape, a conical prism shape, a polygonal pyramid shape, a truncated conical shape, and a truncated polygonal pyramid shape, and preferably has a conical shape.

The light extraction structure may be formed using a photo electro chemical (PEC) method or the like, but the present disclosure is not limited thereto. Since the light extraction structure is formed at the upper surface of the light transmitting electrode layer (not shown) or second semiconductor layer **440**, total reflection of light generated from the active layer **430** is achieved by the upper surface of the light transmitting electrode layer (not shown) or second semiconductor layer **440**. Consequently, it may be possible to prevent reabsorption or scattering of light, thereby enhancing light extraction efficiency of the light emitting device **400**.

A passivation (not shown) may be formed at a side surface and an upper region of the light emitting structure, and be made of an insulation material.

The second electrode **480**, which is electrically connected to the second semiconductor layer **440**, may be formed on the second semiconductor layer **440**, and include at least one pad and/or an electrode having a predetermined pattern. The second electrode **480** may be disposed at a center region, an outer region, or a corner region of the upper surface of the second semiconductor layer **440**, but the present disclosure is not limited thereto. The second electrode **480** may be disposed at a region different from an upper portion of the second semiconductor layer **440**, but the present disclosure is not limited thereto.

The second electrode **480** may include a reflective electrode layer **482** disposed over the second semiconductor layer **440**, and a bonding electrode layer **488**, which is disposed in at least a partial region of an outer side surface of the reflective electrode layer **482** while coming into contact with the second semiconductor layer **440**. Here, the configuration of the reflective electrode layer **482** and bonding electrode layer **488** is the same as described above.

FIGS. **17** to **19** are sectional views illustrating sequential processes of a method for manufacturing the electrode of the light emitting device according to the illustrated embodiment.

Referring to FIG. **17**, first, the first semiconductor layer **120**, the active layer **130**, the second semiconductor layer **140**, and the light transmitting electrode layer **150** are grown in this order.

Subsequently, a photo resist (PR) 10 is disposed on the light transmitting electrode layer **150**. In this case, the PR 10 may have a decreasing width with decreasing distance to an upward direction, but the present disclosure is not limited thereto.

Thereafter, the reflective electrode layer **182** is laminated.

Referring to FIG. **18**, a width wider than that of the reflective electrode layer **182** is secondly created by baking the PR 10 or using another PR.

Subsequently, the bonding electrode layer **188**, the first anti-oxidation electrode layer **184***a*, the second anti-oxidation electrode layer **184***b*, and the third anti-oxidation electrode layer **184***c* are laminated in this order. In this case, the bonding electrode layer **188**, the first anti-oxidation electrode layer **184***a*, the second anti-oxidation electrode layer **184***b*, and the third anti-oxidation electrode layer **184***c* may also be laminated in this order at the side surface of the reflective electrode layer **182**.

Referring to FIG. **19**, the PR 10 is subsequently removed.

Although the method for manufacturing the second electrode **180** is described, the first electrode **170** may be manufactured using the same method as the second electrode **180**.

FIG. **20** is a perspective view illustrating a light emitting device package including a light emitting device according to an exemplary embodiment. FIG. **21** is a sectional view illustrating the light emitting device package including the light emitting device according to the illustrated exemplary embodiment.

Referring to FIGS. **19** and **20**, the light emitting device package, which is designated by reference numeral **500**, may include a body **510** formed with a cavity **520**, first and second lead frames **540** and **550** mounted on the body **510**, a light emitting device **530** electrically connected to the first and second lead frames **540** and **550**, and an encapsulant (not shown) filled in the cavity **520** so as to cover the light emitting device **530**.

The body **510** may be made of at least one of a resin material such as polyphthalamide (PPA), silicon (Si), aluminum (Al), aluminum nitride (AlN), liquid crystal polymer such as photo sensitive glass (PSG), polyamide 9T (PA9T), syndiotactic polystyrene (SPS), a metal material, sapphire (Al_2O_3), and beryllium oxide (BeO), or may be a Printed Circuit Board (PCB). The body **510** may be formed by an injection molding process, an etching process or the like, but the present disclosure is not limited thereto.

The body **510** may have an inclined surface at an inner surface thereof. In accordance with the inclination of the inclined surface, a reflective angle of light emitted from the light emitting device **530** may be varied. Thus, an orientation angle of outwardly emitted light may be adjusted.

As the orientation angle of light decreases, the convergence of light outwardly emitted from the light emitting device **530** increases. On the other hand, as the orientation angle of light increases, the convergence of light outwardly emitted from the light emitting device **530** decreases.

When viewed from the top, the cavity **520** formed at the body **510** may have a circular, square, polygonal or elliptical shape. In particular, the cavity **520** may have curved corners, but present disclosure is not limited thereto.

The light emitting device **530** is mounted on the first lead frame **540**. The light emitting device **530** may be, for example, a light emitting device to emit red, green, blue or white light, or a light emitting device to emit ultraviolet (UV) light, but the present disclosure is not limited thereto. In addition, one or more light emitting devices may be mounted.

The above-mentioned embodiment may be applied to a horizontal type light emitting device having a structure in which electrical terminals of the light emitting device **530** are formed at an upper surface thereof, a vertical type light emitting device having a structure in which electrical terminals of the light emitting device **530** are formed at respective upper and lower surfaces thereof; or a flip chip type light emitting device.

The encapsulant (not shown) may be filled within the cavity **520** to cover the light emitting device **530**.

The encapsulant (not shown) may be made of silicon, epoxy resin, or other resin material. The encapsulant may be formed by filling the cavity **520** with an encapsulating material, and curing the filled material using ultraviolet light or heat.

The encapsulant (not shown) may contain a fluorescent substance.

The kind of the fluorescent substance may be selected depending on a wavelength of light emitted from the light emitting device **530** so that the light emitting device package **500** may realize emission of white light.

The fluorescent substance may be any one of a blue, bluish green, green, yellowish green, yellow, yellowish red, orange, and red luminous fluorescent substances depending on the wavelength of light emitted from the light emitting device **530**.

That is, the fluorescent substance may be excited by light emitted from the light emitting device **530** at a first wavelength, so as to generate light of a second wavelength. For example, when the light emitting device **530** is a blue light emitting diode and the fluorescent substance is a yellow fluorescent substance, the yellow fluorescent substance is excited by blue light, thereby emitting yellow light. In this case, the light emitting device package **500** may provide white light as the blue light generated from the blue light emitting diode and the yellow light generated in accordance with the excitation by the blue light are mixed.

Similarly, when the light emitting device **530** is a green light emitting diode, a magenta fluorescent substance or a mixture of blue and red fluorescent substances may be used as the fluorescent substance. Also, when the light emitting device **530** is a red light emitting diode, a cyan fluorescent substance or a mixture of blue and green fluorescent substances may be used as the fluorescent substance.

The fluorescent substance may be a known fluorescent substance such as a YAG-based, TAG-based, sulfide-based, silicate-based, aluminate-based, nitride-based, carbide-based, nitridosilicate-based, borate-based, fluoride-based, or phosphate-based fluorescent substance.

The first and second lead frames **540** and **550** may contain at least one of metal materials, for example, titanium (Ti), copper (Cu), nickel (Ni), gold (Au), chromium (Cr), tantalum (Ta), platinum (Pt), tin (Sn), silver (Ag), phosphor (P), aluminum (Al), indium (In), palladium (Pd), cobalt (Co), silicon (Si), germanium (Ge), hafnium (Ht), ruthenium (Ru), and iron (Fe), or an alloy thereof. The first and second lead frames **540** and **550** may also be formed to have a single layer structure or a multilayer structure, but the present disclosure is not limited thereto.

The first and second lead frames **540** and **550** are spaced apart from each other and are electrically isolated from each other. The light emitting device **530** may be mounted on the first and second lead frames **540** and **550**. The first and second lead frames **540** and **550** may be electrically connected to each other by directly coming into contact with the light emitting device **530** or through a conductive material such as a soldering member (not shown). Also, the light emitting device **530** may be electrically connected to the first and second lead frames **540** and **550** using a wire bonding method, but the present disclosure is not limited thereto. Accordingly, when a power source is connected to the first and second lead frames **540** and **550**, power may be applied to the light emitting device **530**. Meanwhile, a plurality of lead frames (not shown) may be mounted within the body **510**, and each of the lead frames (not shown) may be electrically connected to the light emitting device **530**, but the present disclosure is not limited thereto.

FIG. **22** is a perspective view illustrating a lighting apparatus including a light emitting device according to an exemplary embodiment. FIG. **23** is a sectional view taken along line C-C' of the lighting apparatus shown in FIG. **22**.

Referring to FIGS. **21** and **22**, the lighting apparatus **600** may include a body **610**, a cover **630** coupled to the body **610**, and end caps **650** located at opposite ends of the body **610**.

A light emitting device module **640** is coupled to a lower surface of the body **610**. The body **610** may be made of a metal material having superior conductivity and superior heat radiation effects so as to outwardly dissipate heat generated from the light emitting device module **640** through an upper surface of the body **610**.

Light emitting device packages **644** may be mounted on a PCB **642** in multiple rows while having various colors, to form a multi-color array. The light emitting device packages **644** may be mounted at the same distance, or may be mounted at different distances to enable brightness adjustment, if necessary. The PCB **642** may be a metal core PCB (MCPCB), a flame retardant-4 (FR4) PCB, or the like.

Each light emitting device package **644** may include an extended lead frame (not shown) so that it may have an enhanced heat dissipation function. Thus, it may be possible to enhance the reliability and efficiency of the light emitting device package **644**. In addition, it may be possible to extend the life span of the lighting apparatus **600**, which includes the light emitting device packages **644**.

The cover **630** may have a circular shape to enclose the lower surface of the body **610**, but the present disclosure is not limited thereto.

The cover **630** serves to protect the light emitting device module **640** from external foreign matter, etc. The cover **630** may contain light diffusion particles to achieve anti-glare effects and uniform emission of light generated from the light emitting device packages **644**. At least one of inner and outer surfaces of the cover **630** may be provided with a prism pattern. Also, a fluorescent substance may be applied to at least one of the inner and outer surfaces of the cover **630**.

Since the light generated from the light emitting device packages **644** is outwardly emitted through the cover **630**, the cover **630** should have high light transmittance and heat resistance sufficient to endure heat generated from the light emitting device packages **644**. To this end, the cover **630** may be made of polyethylene terephthalate (PET), polycarbonate (PC), polymethyl methacrylate (PMMA), or the like.

The end caps **650** may be disposed at the opposite ends of the body **610**, and function to seal a power supply unit (not shown). Each end cap **650** is formed with power pins **652**, so that the lighting apparatus **600** according to the illustrated embodiment may be directly connected to a terminal, from which an existing fluorescent lamp has been removed, without an additional connector.

FIG. **24** is an exploded perspective view illustrating a liquid crystal display apparatus including a light emitting device according to an exemplary embodiment.

FIG. **24** illustrates an edge-light type liquid crystal display apparatus. The liquid crystal display apparatus, which is designated by reference numeral **700**, may include a liquid crystal display panel **710** and a backlight unit **770** for supply of light to the liquid crystal display panel **710**.

The liquid crystal display panel **710** may display an image using the light supplied from the backlight unit **770**. The liquid crystal display panel **710** may include a color filter substrate **712** and a thin film transistor substrate **714**, which face each other with liquid crystals interposed therebetween.

The color filter substrate **712** may realize the color of an image displayed through the liquid crystal display panel **710**.

The thin film transistor substrate **714** is electrically connected to a printed circuit board (PCB) **718**, on which a plurality of circuit elements is mounted, by means of a drive film **717**. The thin film transistor substrate **714** may apply drive voltage provided by the PCB **718** to liquid crystals in response to a drive signal transmitted from the PCB **718**.

The thin film transistor substrate **714** may include pixel electrodes and thin film transistors in the form of thin films formed on another substrate made of a transparent material such as glass or plastic.

The backlight unit **770** includes a light emitting device module **720** to emit light, a light guide plate **730** to change light emitted from the light emitting device module **720** into planar light and to provide the planar light to the liquid crystal display panel **710**, a plurality of films **752**, **766** and **764** to enhance uniformity in luminance distribution and vertical light incidence of light emerging from the light guide plate **730**, and a reflective sheet **747** to reflect light emitted rearwards from the light guide plate **730** toward the light guide plate **730**.

The light emitting device module **720** may include a plurality of light emitting device packages **724** and a PCB **722** on which the plural light emitting device packages **724** are mounted to form an array. In this case, reliability of the bent light emitting device packages **724** mounted on the PCB **722** may be improved.

The backlight unit **770** may include a diffusion film **766** to diffuse light incident thereupon from the light guide plate **730** toward the liquid crystal display panel **710**, and a prism film **752** to converge the diffused light so as to enhance vertical light incidence. The backlight unit **770** may further include a protective film **764** to protect the prism film **752**.

FIG. **25** is an exploded perspective view illustrating a liquid crystal display apparatus including a light emitting device according to an exemplary embodiment. Here, the same configuration as that illustrated in FIG. **24** will not be repeatedly described in detail.

FIG. **25** illustrates a direct type liquid crystal display apparatus. The liquid crystal display apparatus, which is designated by reference numeral **800**, may include a liquid crystal display panel **810** and a backlight unit **870** for supply of light to the liquid crystal display panel **810**.

Since the liquid crystal display panel **810** is similar to that of FIG. **24**, no detailed description thereof will be given.

The backlight unit **870** may include a plurality of light emitting device modules **823**, a reflective sheet **824**, a lower chassis **830** in which the light emitting device modules **823** and reflective sheet **824** are accommodated, a diffusion plate **840**, and a plurality of optical films **860**, the diffusion plate **840** and the optical films **860** being disposed over the light emitting device modules **823**.

Each light emitting device module **823** may include a plurality of light emitting device packages **822**, and a PCB **821** on which the plural light emitting device packages **822** are mounted to form an array.

The reflective sheet **824** reflects light generated by the light emitting device packages **822** toward the liquid crystal display panel **810**, thereby achieving an enhancement in light utilization efficiency.

Meanwhile, the light generated from the light emitting device modules **823** is incident upon the diffusion plate **840**. The optical films **860** are disposed over the diffusion plate **840**. The optical films **860** may be comprised of a diffusion film **866**, a prism film **850** and a protective film **864**.

As is apparent from the above description, a light emitting device includes an electrode, which has a superior bonding property to a semiconductor layer and has high light reflectivity, and thus it may be possible to enhance luminous efficiency and prevent peeling-off of the electrode from the semiconductor layer.

Although embodiments have been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and applications may be devised by those skilled in the art that will fall within the intrinsic aspects of the embodiments. More particularly, various variations and modifications are possible in concrete constituent elements of the embodiments. In addition, it is to be understood that differences relevant to the variations and modifications fall within the spirit and scope of the present disclosure defined in the appended claims.

What is claimed is:

1. A light emitting device comprising: a light emitting structure comprising a first semiconductor layer, a second semiconductor layer, and an active layer between the first and second semiconductor layers; a first electrode electrically connected to the first semiconductor layer; and a second electrode disposed on the second semiconductor layer, wherein the second electrode comprises: a reflective layer disposed on the second semiconductor layer; a metal layer disposed on a side surface of the reflective layer and on a top surface of reflective layer, wherein the metal layer has a first layer, and a second layer on the first layer, wherein the first layer is contacted with an upper surface of the second semiconductor layer, wherein the first layer contains chromium (Cr), and the second layer contains aluminum (Al); a first anti-oxidation layer formed only on an upper surface of the metal layer; and a second anti-oxidation layer formed only on an upper surface of the first anti-oxidation layer, wherein the second anti-oxidation layer is more than 10 times thicker than the first anti-oxidation layer.

2. The light emitting device according to claim **1**, wherein the first anti-oxidation layer and second anti-oxidation layer comprise at least one of gold (Au), rhodium (Rh), palladium (Pd), copper (Cu), nickel (Ni), ruthenium (Ru), iridium (Ir), and platinum (Pt).

3. The light emitting device according to claim **1**, wherein the first anti-oxidation layer is made of nickel (Ni).

4. The light emitting device according to claim **3**, wherein the second anti-oxidation layer is made of gold (Au).

5. The light emitting device according to claim **1**, wherein the first anti-oxidation layer has a thickness of 400 Å to 600 Å.

6. The light emitting device according to claim **5**, wherein the second anti-oxidation layer has a thickness of 7500 Å to 8500 Å.

7. The light emitting device according to claim **1**, wherein the reflective layer has a multi layer structure including a silver (Ag).

8. A light emitting device comprising: a light emitting structure comprising a first semiconductor layer, a second semiconductor layer, and an active layer between the first and second semiconductor layers; a first electrode electrically connected to the first semiconductor layer; and a second electrode disposed on the second semiconductor layer, wherein the second electrode comprises: a reflective layer disposed on the second semiconductor layer; a metal layer disposed on a side surface of the reflective layer and on a top surface of reflective layer; and an anti-oxidation layer formed only on an upper surface of the metal layer, wherein the reflective layer has a multi layer structure including a silver (Ag), wherein the metal layer has a chromium (Cr) layer, an aluminum (Al) layer, and wherein the Cr layer is contacted with an upper surface of the second semiconductor layer, wherein the chromium (Cr) layer, the aluminum (Al) layer are laminated in this order.

9. The light emitting device according to claim **8**, wherein the Cr layer has a thickness of 15 Å to 25 Å.

10. The light emitting device according to claim **9**, wherein the Al layer has a thickness of 2800 Å to 3200 Å.

11. The light emitting device according to claim **8**, wherein the anti-oxidation electrode layer comprises at least one of gold (Au), rhodium (Rh), palladium (Pd), copper (Cu), nickel (Ni), ruthenium (Ru), iridium (Ir), and platinum (Pt).

12. A light emitting device comprising:

a light emitting structure comprising a first semiconductor layer, a second semiconductor layer, and an active layer between the first and second semiconductor layers; a first electrode electrically connected to the first semiconductor layer; and a second electrode disposed on the second semiconductor layer, wherein the second electrode comprises: a reflective layer disposed on the second semiconductor layer; a metal layer disposed on a side surface of the reflective layer and on a top surface of reflective layer; a first anti-oxidation layer formed only on an upper surface of the metal layer; and a second anti-oxidation layer formed only on an upper surface of the first anti-oxidation layer, wherein the second anti-oxidation layer is more than 10 times thicker than the first anti-oxidation layer, wherein the reflective layer has a multi layer structure including a silver (Ag), wherein the metal layer has a first layer, and a second layer on the first layer, wherein the first layer is contacted with an upper surface of the second semiconductor layer, wherein the first layer contains chromium (Cr), and the second layer contains aluminum (Al), wherein the second electrode is disposed on a part of the second semiconductor layer, and wherein an area of a top surface of the second semiconductor layer is 2 times larger than that of a top surface of the second electrode.

13. The light emitting device according to claim **12**, wherein the first anti-oxidation layer and the second anti-oxidation layer comprise at least one of gold (Au), rhodium (Rh), palladium (Pd), copper (Cu), nickel (Ni), ruthenium (Ru), iridium (Ir), and platinum (Pt).

14. The light emitting device according to claim **12**, wherein the first anti-oxidation layer is made of nickel (Ni).

15. The light emitting device according to claim **14**, wherein the second anti-oxidation layer is made of gold (Au).

16. The light emitting device according to claim **12**, wherein the first anti-oxidation layer has a thickness of 400 Å to 600 Å.

17. The light emitting device according to claim **16**, wherein the second anti-oxidation layer has a thickness of 7500 Å to 8500 Å.

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